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& SALIM A. ALI.

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THE MALAYAN BANDED CRAKE

Rallina fasciata

$\frac{2}{3}$ life size

JOURNAL
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AUGUST, 1927 VOL. XXXII No. 1

THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

PART III

(*With a coloured plate*)

(*Continued from page 546 of Vol. XXXI*)

AMAURORNIS FUSCUS

The Ruddy Crake

There are four forms of this little Crake found within the Indian Empire, viz.:

(1) *Amaurornis fuscus fuscus.* The Ruddy Crake.
Rallus fuscus Linn., Syst. Nat., 12th ed., I., p. 262, 1766, Philippines.
This and the Ceylon form are the smallest of the four forms, with a wing between 89 and 99 mm.; the colour the same as in *P. f. bakeri* but deeper both above and below. It is found from the Philippines through Celebes, Java, Sumatra and Borneo, etc., all through the Malay Peninsula to Tenasserim.

(2) *Amaurornis fuscus bakeri.* The Northern Ruddy Crake.
Porzana fusca bakeri Hartert; Nov. Zool., 1917, p. 262 Kumaon.
Larger than the preceding bird with a wing of 97 to 110 mm. Similar in colour. Inhabiting Northern India from the

Afghan Frontier (Whitehead) and Kashmir to Eastern Assam and Bengal, Chin Hills and Arakan.

(3) *Amaurornis fuscus erythrothorax.* The Chinese Ruddy Crake.

Gallinula erythrothorax Temm. and Schlegel, Fauna Jap. Aves, p. 121, pl. 28, 1849, Japan.

This is the largest and palest of all the known forms, the wing 105 to 120 mm. ; the lower parts a paler rufous and the crown less rufous anteriorly. This form occurs only, as far as is yet known, in the Shan States within our limits. Outside these it ranges from Japan and China to Yunnan and Siam.

(4) *Amaurornis fuscus zeylonicus.* The Ceylon Ruddy Crake.

Amaurornis fuscus zeylonicus Stuart Baker, Bull. B. O. C. Jan. 1927.

A small form about equal in size to *A. f. fusca* but much paler and faintly tinged above with yellowish. Omitting one very faded specimen, the darkest Ceylon bird is not quite so dark as the palest Javan or Malayan specimen. Ceylon and South-West coast of India to Belgaum and Kanara.

Description.—Forehead and crown to the sinciput, sides of the head and neck, lower plumage to abdomen vinous chestnut ; upper plumage dark olive brown, the rump, upper tail coverts, tail and wing quills darker brown ; flanks and abdomen olive brown ; under tail-coverts blackish-brown, edged with white ; chin and centre of throat white more or less tinged with chestnut.

Colours of soft parts.—Iris crimson, brown in young birds, glaucous blue-brown in nestlings ; bill horny green to brownish green, the tip of the lower mandible yellowish ; eyelids plumbeous grey with a red rim ; legs and feet reddish-orange to brick red.

Measurements.—A. f. fusca. Total length about 220 to 230 mm. ; wing 87 to 99 mm. ; tail about 55 mm. ; culmen 19 to 21 mm. ; tarsus 37 mm.

A. f. erythrothorax. Wing 105 to 122 mm. ; culmen 21 to 24 mm.

A. f. bakeri. Wing 97 to 110 mm. ; culmen 21 to 24 mm.

A. f. zeylonicus. Wing 87 to 96 mm. ; culmen 19 to 20 mm.

As already noted, the depth of colour varies in the different geographical races, but the above description fits them all.

Young Birds are darker above, and have the crown concolorous with the back ; supercilia, sides of head and neck and lower surface dull white barred everywhere with dusky brown ; flanks and thighs dull olive-brown ; under tail-coverts as in adults.

Nestling black with fulvous spots behind the ear-coverts.

Distribution : *vide supra.*

Nidification.—The Ruddy Crake breeds wherever it is found, though birds may move about considerably under the effect of drought, heavy rainfall or other local conditions, whilst it is possible that many of the rails which swarm in the swamps and lakes of Eastern Bengal in Winter breed further north. I have personally found them breeding in the Sunderbands of E. Bengal, Mymensingh and the Surma Valley in June, July and August whilst in Kashmir,

Osmaston and others have taken eggs from May to September. In South Siam, Herbert found it breeding in July, whilst in Ceylon eggs have been taken in August and September, and in Travancore in June. Further north, Davidson took nests with eggs in Kanara from May on to August. The nest is a fairly substantial pad of grass, rush blades or similar materials, which is placed either on or quite close to the ground in swampy places, marshy fields or in islands in the middle of swamps. Occasionally the nest is placed in reeds, rank grass or bushes growing in water, but this is exceptional. The eggs generally number 5 or 6, more rarely 7 or even 8. The ground colour is a pale cream, sometimes a little deeper, and sometimes almost white, whilst every now and then one comes across a clutch of an almost deep red-pink. The marks consist of numerous ill-defined flecks, irregular blotches and spots of rufous-brown to deep reddish-brown, fairly numerous over the whole surface and generally more so at the larger end; the secondary markings, not always visible, are similar but more scanty and of a pale mauve, neutral tint or reddish-lilac. The surface is smooth but not glossy, and the texture strong and close. Thirty-four eggs of the southern form average 30·0 × 22·5 mm.; one hundred of the northern form average 32·3 × 23·7 mm.; whilst the only two clutches which I have seen of the Malayan bird were only about 29·0 × 23·0 mm., and were broader in comparison than any of the others. Typically they are rather smudgy ill-marked eggs compared with the more boldly spotted eggs of *Hypotænidia*.

Habits.—The Ruddy Crake is possibly a much more common bird than people imagine, but it is such a desperate little skulker that it is most difficult to flush. When snipe-shooting in Eastern Bengal we often found that in the hotter hours of the day the snipe deserted the rice fields and shallow mud and water round the edge of the swamps, taking refuge from the heat under the lilies, lotuses and other plants growing in deeper water. It was whilst pursuing these snipe that I first came across this very attractive little Crake. There was no chance in this deep water of running, so that any birds we disturbed were forced to fly and, in consequence, we were constantly putting up tiny birds which flew much like quails for two or three hundred yards and then, after swerving a little to the right or left, dropped suddenly down to the water plants again. The legs were always visible as they rose so that I guessed them to be rails of some kind, and shooting one found it to be a Ruddy Crake. As long as the sun was high and hot we could be sure of putting up any number of these quaint little birds, though shooting in the early mornings and late afternoons one but seldom saw them as they were then feeding where the cover was ample, and they could escape without flying. Their diet is both insectivorous and vegetarian and they, sometimes at least, also eat tiny fresh water molluscs. Its note, so far as I have heard it, is a very soft *crake*, not rapidly repeated but uttered as a single note at considerable intervals. It appears to be uttered only in the very early mornings and the evenings, and then but rarely. Hume syllabifies this as *keek-keek-keek*. Even where the birds were most numerous, as in the Sunderbunds, they were but seldom to be heard, though I was

never in these districts during the breeding season when they may be more loquacious. They keep much to rice fields during the day, though they also haunt all kinds of swamps and marshes and may sometimes be found in marshy meadows at a considerable distance from any water. Round about villages, they may sometimes be seen on quite small pieces of water and they then become quite used to humanity and very tame. They seem good-tempered little birds, several pairs feeding in company without squabbling or fighting, even at the commencement of the breeding season. For the table they are of no use, though Hume says that when skinned and disguised with onions, etc., they are quite eatable.

Amaurornis phœnicurus

The White-breasted Water Hen

The White-breasted Water Hen has three geographical races within our limits, including the typical form. These are :—

(1) *Amaurornis phœnicurus phœnicurus.* The Ceylon White-breasted Water Hen.

Rallus phœnicurus Pennant, Ind. Zool., ix. p. 10, 1769, Ceylon.

Inhabiting Ceylon and South Travancore only.

(2) *Amaurornis phœnicurus chinensis.*—The Chinese White-breasted Water Hen.

Fulica chinensis, Boddaert, Tabl. Pl. Enl. p. 54, 1783, China.

Found throughout India, Burma, China.

(3) *Amaurornis phœnicurus insularis.*—The Andaman White-breasted Water Hen.

Amaurornis insularis Sharpe, Cat. B. M. xxiii, p. 163, 1894, Andamans.

Known from the Andamans only.

Rather larger than either of the two preceding birds, and darker and blacker in general colour, with more extended white on the forehead.

Vernacular Names.—Dawak, *Dahak*, *Dauk* (Hin.); *Kimati* (Oudh); *Kurahi* (Sind.); *Kureyn* (Gond); *Bole-Radi* (Tel.); *Tannin Koli*, *Kannung Koli* (Tam. Ceylon); *Kulu-quet* (Burm.); *Di-dao-ho-gophu* (Cachari).

Description.—Forehead, supercilia, sides of the head, chin to vent pure white; upper parts, wings and sides of the body from breast to vent dark slaty-grey more or less washed with olive, and the upper tail-coverts generally browner; tail and wing quills blackish, the first primary with white outer web, posterior flanks, thigh-coverts, vent and under tail-coverts dingy rufous; axillaries and under wing-coverts slaty edged with white.

Colours of soft parts.—Iris brown in the young to crimson in the breeding male; bill green, the base of the upper mandible red, the tip and lower mandible paler and more yellow; legs and feet dull chrome-yellow to yellowish-green.

Measurements.—A. phœnicurus phœnicurus.—Total length about 320 mm.; wing 142 to 160 mm.; tail 58 to 66 mm.; tarsus 49 to 57 mm.; culmen 35 to 42 mm.

A. p. chinensis. Wing 158 to 173 mm.; culmen 36 to 41 mm.

A. p. insularis. Wing 157 to 173 mm.; culmen 37 to 44 mm.

Young Birds have the feathers of the forehead and face tipped with slaty and the white obscured; the upper parts generally are olive-brown rather than slaty-gray.

Distribution.—As given above.

Nidification.—The White-breasted Water Hen breeds from June to September over the greater part of the area in which it is found but Messrs. Wait, Phillips and Jenkins have taken eggs in almost every month of the year in Ceylon, whilst in Assam, Burma and China many birds commence breeding in May. The commencement of their breeding agrees in fact, as it does with other water-birds in the tropics, with the break of the rains. As soon as the swamps and lakes begin to fill, the birds set about their domestic duties, and by the time the insect world is at its worst and thickest, the eggs hatch and the young have a super-abundance of food. So entirely are nesting proceedings governed by the rainfall that the breeding commences late or early just as the rain itself is late or early, whilst in some seasons of drought the birds desert the driest areas altogether and betake themselves to more congenial surroundings, or, if they remain, do not breed at all. The nest varies very much both in character and in position. Sometimes it is placed in among tangles of reeds, coarse grass, cane brakes, or any of the other forms of vegetation which grow either in the swamps or immediately round them. In these cases the nest may be just clear of the water or as much as two or three feet above it, whilst in appearance it is just a heavy, large edition of that of the common Coot or Moorhen. At other times it is built quite high up in bushes, trees or palms and it is then often made of twigs, creepers and such other material as may be handy for the purpose. Oates states that most of the nests he found in South Burma were high up in trees, not below ten feet. In Assam most of our nests were found close above the water, but one we found high up in a pepul tree and another pair of birds had laid in the deserted nest of a Fish-eagle. I have seen many hundred nests, and think six or seven eggs is the number most often laid, and four or five only are often found incubated. Bingham found eight to be the normal full clutch in Tenasserim, but, on the other hand, in Ceylon, three or four eggs only are normally laid and five is exceptional. In shape the eggs are rather long ovals, very obtuse at the smaller end and sometimes rather cylindrical. The surface is fairly smooth and fine and sometimes faintly glossy. The ground colour varies from a very faint yellow-cream to yellowish-stone or pale buff, never of any great depth. The markings consist of blotches and spots, irregular and, generally, rather longitudinal in shape, scattered sparsely over the whole surface and rather more numerous at the larger end. The primary or superficial characters are light reddish-brick to rather dark brownish-red, whilst the secondary or underlying marks are lavender grey, neutral tint or purplish. The eggs are very like those of the Ruddy Crake except in size. The average sizes for the eggs of the various races are as follows:—

A. p. chinensis. 100 eggs 40·5 × 29·7 mm.

A. p. insularis. 50 eggs 40·8 × 31·0 mm.
A. p. phœnicurus. 40 eggs 36·8 × 30·0 mm.
Maxima 45·0 × 30·0 mm. (Burma) and 43·0 × *32·2* mm. (Andamans).
Minima 37·0 × *28·0* mm. (Ceylon).

Habits.—This Rail is, I think, much less of a skulker than most of its tribe and its larger size, also, makes it a less easy matter to hide. It, of course, keeps as a rule closely to cover, more especially to reeds, rushes and cane brakes, whilst at other times it creeps about in the forest and jungle surrounding the swamps, lakes or ponds in which it feeds in the mornings and evenings. At the same time it may often be seen wandering about over the water weeds, or swimming from one patch of cover to another, quite in the open, and I have often watched them feeding for half an hour at a time. They are very active walkers over weeds and lotus leaves, moving with rather long, deliberate strides, each foot lifted high and the tail jerking in unison with each step whilst every now and then there is an additional quick jerk upwards. It is, on the whole, a bold bird and may often be seen wandering about on the banks of village, ponds and ditches and, indeed, often breeds on these. It feeds on shoots of rice and water plants, reeds, grain, insects, mollusca and worms, etc. It is a noisy bird in the breeding seasons, and emits sounds quite astonishing for the size of the bird. E. H. Aitken describes its breeding call thus :—

> 'Anything more unearthly proceeding from the throat of a bird I never heard. It began with loud, harsh roars which might have been elicited from a bear by roasting it slowly over a large fire, then suddenly changes to a clear note repeated like the coo of a dove.'

They are pugnacious birds, and two cocks meeting in the open during the breeding season are sure to fight, but the damage done seems never to be serious, and they never continue the scrap with the pertinacity of the Water-Cock.

Amaurornis akool akool

The Brown Crake

Rallus akool Sykes, P.Z.S., 1832, p. 164, Deccan.
Vernacular Names.—None recorded.

Description.—Whole upper parts, wings and tail dark olive-brown, the quills rather darker brown and less olive ; lores, indistinct supercilia, sides of head and neck and lower plumage ashy-grey, passing into brown on the posterior abdomen, vent and under tail-coverts ; chin and centre of throat whitish passing into the grey of the surrounding parts.

Colours of soft parts.—Iris brown in young birds to blood-red in breeding males ; bill greenish-horny or pale-green, more blue at the tip ; legs and feet fleshy-brown to livid purple.

Measurements.—Wing 114 to 131 mm. ; tail 54 to 63 mm. ; tarsus 46 to 51 mm. ; culmen 28 to 32 mm. Females average smaller than males.

Chick in down.—Black.

Distribution.—Northern India from Kashmir to Gowhati in West Assam ; south to Bengal, Behar, Central Provinces, the South

Deccan, Mysore and Rajputana. I cannot trace any specimen from North Khasia Hills, nor did I ever see it there myself. There is on the other hand a specimen from Gowhati in the Kamroop District.

Nidification.—The Brown Crake breeds from May to September, making a pad nest of reeds, grass or rushes, and water weeds either in among the reeds quite close above the water or a more substantial nest of the same materials mixed with twigs, leaves and creepers which it places in a thick bush or tangle of canes in or close to the water. Occasionally it makes use of a bush in thick undergrowth some distance from any swamp or open water but nine nests out of every ten will be found practically in the swamp or alongside the margins. The nest is nearly always well concealed, and, as it is small for the size of the bird, is not easy to find. The number of eggs laid varies from four to six, and in appearance they are very like rather richly coloured eggs of the Common Water-Rail. The normal shape is a broad, blunt oval, almost spheroid, and the texture is very fine and close, often well glossed. The ground colour is anything from a pale yellow—or pinkish-stone to a warm salmon or buff. The markings consist of fairly bold, well-defined spots and blotches of pale reddish-brown to deep reddish-purple, scanty everywhere but rather less so at the larger end.

Fifty eggs average 34·9 × 26·5 mm.; *Maxima 38·8* × 27·2 and 37·7 × 28·0 mm.; *Minima 31·8* × 26·7 and 34·9 × *25·2* mm.

Habits.—Blewitt sixty years ago gave an admirable account of this Rail. He writes:—

> 'I have met with it nearly always singly, occasionally in pairs. Its favourite resorts are swamps, the reeds and bushes on the edge of streams, and the tangled amphibious coverts on the border of water-courses. A favourite place of abode too is the marshy ground occupied by Keurak Plants, the branches and broad leaves of which it ascends like *Erythra phœnicura*, with wonderful agility. I have always found it a shy bird, seeking at once a place of security on the slightest alarm. Frequently I have witnessed it half emerge from the rushes, either to feed or change its retreat, and then pause, carefully scanning the neighbourhood before venturing onward. When walking, it ever and anon jerks up its short tail. It runs with rapidity, and when once concealed it is very difficult to flush it; indeed, it would appear rightly to trust far more for safety to its speed of foot and aptitude for concealment than to its powers of flight.
>
> "Slowly and heavily does it fly, and never to any distance, and with good dogs it may be run down and secured. This Rail has a short plaintive note, which, however, I have only heard it utter at daybreak and just before sunset."'

It by no means always keeps to marshes and swamps, but often seems to feed on dry and even on open ground where much of its food consists of land snails, slugs, worms, etc. Like the rest of the Rails, it is a shy, secretive bird, avoiding observation.

Amaurornis bicolor

Elwes' Crake

Porzana bicolor Walden, Ann. Mag. Nat. His. 4), iv, p. 47, 1872, Sikkim.

Vernacular Names. None recorded.

Description.—Head, neck and lower plumage dark ashy grey, darkest on the crown and nape and paler on the sides of the head, changing to albescent on the chin; upper parts, wing-coverts and inner secondaries rich brownish-rufous; tail black; wing-quills dark brown.

Colours of soft parts.—Iris brown in the young to blood-red in breeding males; bill pale glaucous-green tipped paler and greyer and with a red patch near the base, more vivid in the breeding season; legs and feet dull red to rather bright brick-red.

Measurements.—Wing 112 to 119 mm.; tail 57 to 60 mm.; tarsus 37 to 39 mm.; culmen 21 to 27 mm.

Distribution.—Nepal and Sikkim to Eastern Assam; Khasia and Cachar Hills, Manipur and Northern Burma to Yunnan and the Shan States.

Nidification.—This Crake breeds in considerable numbers in the Khasia Hills, as also in the North Cachar Hills in the few places suitable to it. In Sikkim it is said to breed between 4,000 and 6,000 feet, but in Assam we took nests anywhere above 3,000 feet, whilst in Dibrugarh it was not uncommon practically down to the foothills. Most of the nests personally found by me were in quite small patches of jungle round about, or between, rice fields at an elevation of some 5,500 feet. Here they were very numerous, and I found nearly a dozen birds breeding in a small patch about 100 yards long by 60 wide. The nest differed in no way from that of the Brown Crake and was usually built a few inches above the water, though one was built up in a rhododendron tree in deep forest and some way from water.

The eggs only differ from those of the Brown Crake in being more richly coloured. 80 eggs average 33·9 × 26·1 mm.; *Maxima 36·3* × 25·3 and 35·3 × *27·0* mm.; *Minima 31·3* × 26·1 and 32·3 × *25·1* mm.

The breeding season is from the middle of May to the end of August, and the number of eggs laid varies from 5 to 7.

Habits.—The habits of Elwes' Crake are much the same as those of the Brown Crake. In the hills south of the Brahmapootra we found it kept to patches of jungle, scrub and rushes between or round the rice cultivation or, where there was none of this, to small ponds and pools in or near forest. They also frequented small streams, especially those which had plenty of cover on one side and open grass land on the opposite one. They often came out of the cover in the early mornings and late evenings and fed on the grass land, picking up small grasshoppers, land shells and small worms. On the least sign of danger they scuttled down to the bank and either swam or flew to the cover on the far side. When frightened they ran with head and tail depressed and covered the ground at a

great pace, but at other times their walk was the usual slow jerky movement affected by all Rails. I have never heard their call, even in the breeding season, though I attributed to this bird a deep grunting noise, very loud and resonant, which I sometimes heard, late in the evening, in their favourite haunts.

Rallina superciliaris superciliaris

The Banded Crake

Rallus superciliaris Eyton, Ann. Mag. Nat. His., xiv, p. 230, 1834, Malay Peninsula.

Rallina superciliaris, Blanf. and Oates, iv, p. 167.

Vernacular Names.—Daobui-lai (Cachari).

Description.—Chin and throat pure white, in younger birds more or less tinged with rufous; head, neck and breast chestnut; remaining upper parts and wing-coverts dark brown slightly washed with olive; wing-quills dark brown; lower breast, abdomen and under parts barred black and white, the centre of the abdomen practically unmarked with black.

Colours of soft parts.—Iris crimson-red or blood-red; bill green, the terminal half of the upper mandible and tip of lower dark brown; legs dull greenish-plumbeous, plumbeous or black.

Measurements.—Total length about 250 mm.; wing 122 to 132 mm.; tail 55 to 64 mm.; tarsus 39 to 46 mm.; culmen 27 to 28 mm.

Young birds have the upper parts of the head and neck concolorous with the back; sides of the head and neck more ashy-brown; breast brown; inner webs of quills more or less barred with dull white, a few white and black bars on scapulars and wing-coverts.

Irides dull brown; legs greenish-plumbeous.

Distribution.—Ceylon and the sub-Himalayas from the North-West Frontier to E. Assam. Thence in small numbers here and there throughout the well-wooded, wetter parts of India. It also occurs in South Burma, the Malay States and Annam.

In the Philippines its place is taken by *R. s. eurizonoides*, a race with deeper rufous colour and either no white or very little on the chin and throat.

Nidification.—In 1900 and succeeding years General R. M. Betham found this bird breeding in considerable numbers on the ghats near Khandalla. In some notes to me he writes:—

> 'This rail is apparently common on the ghats at Khandalla, near Poona, during the monsoon. It was probably overlooked as so few people visit these spots at this season, owing to the excessive rainfall.
>
> 'My shikari first brought me the eggs which were puzzling as they were so unlike other rails. He, however, managed to secure the bird with the eggs so we were fortunately able to identify them.
>
> 'It breeds in thick jungle or, rather, in dense tangles of bushes and other vegetation, and its nest is not easy to find.'

Prior to this in 1898 Bell and Hervey had already taken many of its nests and eggs round about Kanara. This is recorded in this Journal (vol. xiv, p. 394) as follows:—

'We found that the Banded Crake was a fairly common bird in the jungles along the coast during the monsoon, and we obtained altogether some dozen nests with eggs varying in number from 4 to 7 in the clutch, besides finding many empty ones. All the nests with eggs were found in the months of June to September, i.e., during the heavy rains. Many nests were found robbed of their contents by mongooses, etc., the empty egg-shells lying on the ground below, some few there were in which the eggs were rotten. The nests are placed in bamboo clumps, on creeper masses, on the top of a tree stump, etc., and were, at the most, six feet from the ground. The size of the egg is about 1·30″ × 1″ on an average; one of the largest out of a series of 50 measures 1·40″ × 1·20″. The birds breed in the densest jungles as well as in the scrub jungle, from sea level up to the tops of the highest hills, which are here about 1,800 feet.'

Including Bell's figures the average for 90 eggs is 33·7 × 26·0 mm.; *Maxima 35·8* × 25·4 mm. and 35·1 × *28·1* mm.; *Minima 30·9* × *25·0* mm. The texture of the eggs is *sui generis*; something between the thick shiny, chalky texture of the egg of the Crow-pheasants and that of the Herons, but nearer the former, and it is most interesting to find that the eggs of these two primitive birds, the Rails and the non-parasitic Cuckoos, should be so much alike and so reptilian in character. In shape the eggs are very round, blunt ovals.

Osmaston took two nests containing 7 and 5 eggs respectively in June and July near Dehra Dun. In the latter case the parent bird attacked his hand, leaving her nest for the purpose, and then returned to sit on her eggs. The native shikaris told Betham that they sat very tight and would almost allow themselves to be captured by hand.

Habits.—Bell's comments on the habits of these Rails forms an excellent summary:—

'What Mr. Davidson says about its habit of calling in the mornings and evenings is correct; but it calls at other times during wet, misty weather. The cry is rather like that of the common hen after laying an egg; but there is a difference. Suddenly disturbed, it utters the cry of the common paddy bird (*Ardeola grayi*) when alarmed; if suspicious of danger it makes a noise like *'k—r—r—r—r—r'*; pronounced in a subduced voice. It is extremely shy of open ground, and will invariably fly across even a few feet of open path in the jungle. When flushed it takes to the nearest tree or any thickly foliaged place available and is quite at home perched on a branch. We have put up many during our walks, generally with dogs. I have never seen one during the dry months, though I am constantly in their breeding haunts during that time. Whether they migrate or not from the district we do not know for certain, but it seems probable.

'In the jungles they go about with their wings slightly hanging. They feed on insects.'

As regards their migration it is unlikely that they will be found to do more than move locally if even that. It seems probable that in the dry season they move away to those swamps and lakes which never dry up even in the longest droughts, so it ma ybe that they move north to those limitless wet areas lying below the foot-hills of the Himalayas. Even this, to me, seems unlikely and, when we have unravelled the mystery of their movements, we may find that they are very restricted.

RALLINA FASCIATA

The Malayan Banded Crake

Rallus fasciatus Raffles, Trans. Lin. Soc., xiii, p. 328, 1822, Malay Peninsula.

Rallina fasciata, Blanf. and Oates, iv, p. 169.

Vernacular Names.—None recorded.

Description.—Whole head, neck and breast deep chestnut, the chin and throat often a little paler and the crown darkest; remaining upper parts, scapulars and innermost secondaries rufous-brown; wing-coverts black with broad white bars; quills dark brown, barred on both webs with whitish; below broadly barred with black and white, the latter more or less rufous on the longest feathers.

Colours of soft parts.—Iris crimson or blood-red; bill blackish, the base paler and tinged with greenish or plumbeous-slate; gape and orbital skin crimson; legs and feet coral-red; claws slate or horny-blue.

Measurements.—Length about 240 to 250 mm.; wing 118 to 131 mm.; tail 49 to 51 mm.; tarsus 42 to 48 mm.; culmen 20 to 21 mm.

Young Birds have the head and neck the same colour as the back; the breast is pale dull brown and the remaining under parts are whitish obscurely marked with brown bars.

Distribution.—From Karennee and Rangoon south through the Malay Peninsula to the Celebes and Moluccas, Borneo, Java and Sumatra.

Nidification.—There appears to be nothing on record about the breeding of this Rail, but Mr. Kellow took several sets of eggs for me near Simpang in the Federated Malay States. The nests were said to be rather rough platforms of grass, twigs and other scraps of vegetation placed on or under bushes in small ravines a long way from any water. In 1904 Wickham took a nest with 5 eggs. The nest was said to be

> 'a pad of dead bamboo leaves with a few dry twigs placed on the ground under the thin cover of a small bush. I made many attempts to secure the old bird—one including three devices, one cast with a fishing net in the daytime, twice shot at (once on the nest), and the setting of nooses; in spite of all these failures I was lucky enough to get the old male caught on the nest at night with a cast-net. The nest was in a small patch of bamboo tree jungle, rather dark, not very thick undergrowth in the bend of a stream which dries up in the hot weather,

leaving perhaps a pool or two, but was at this time a flowing stream ; the particular patch of jungle used bordering the paddy land.'

The nest was taken on June 29.

Mr. Hopwood also obtained a nest of this bird containing four eggs, quite fresh. This nest, as well as those from Simpang, were all taken in August. It contained four eggs which together with the Malay ones are now in my collection. They are of the same curious texture, shape and colour as those of *R. superciliaris*. They average 31·5 × 23·9 mm. ; *Maxima 35·0 × 25·4* mm. ; *Minima 27·2 × 21·9* mm.

Habits.—Much the same as those of the preceding bird, and probably like it resident wherever found, in spite of the fact that so many are caught taking refuge in houses in a completely exhausted condition. The first bird I ever saw was a young female caught by one of my servants in their house, very exhausted when caught, but reviving at once and fiercely attacking the hands of her capturer, uttering hoarse grunts rather like a dog growling. Probably she had been pursued by some nocturnal vermin, and took shelter in the first hiding-place she found. This was in North Cachar in December at about 2,500 feet. I also found this bird breeding there, capturing a hen bird and one young—out of several —on her nest. It must be as great a skulker as any other Rail, for I hardly ever saw one unless accompanied by dogs, as nothing would make them fly and, far from flying across open paths in the jungle, they always scuttled across as hard as they could. In Assam it was a bird of dense jungles only, but in Lower Burma and the Malay States it seems to come more into jungle surrounding villages and cultivation.

Rallina canningi

The Andamanese Banded Crake

Euryzona canningi (Tytler), Blyth, Ibis, 1863, p. 119. Port Canning, Andamans.

Rallina canningi, Blanf. & Oates, iv, p. 169.

Vernacular Names.—None.

Description.—Whole upper plumage, head, neck, breast and inner secondaries deep chestnut ; wing-coverts the same, but a few of the median and greater obsoletely barred with white and dark brown ; primaries and outer secondaries dark brown edged with chestnut barred on the inner webs with whitish, and also, less distinctly on the outer webs of the first two or three primaries, lower parts boldly barred with black and white.

Colours of soft parts.—Iris red ; bill pale-green; legs and feet olive-green.

Measurements.—Total length 325 to 350 mm. ; wing 151 to 163 mm. ; tail 73 to 92 mm. ; tarsus 56 to 62 mm. ; culmen 29 to 33 mm. As usual in Rails the males exceed the females in *average* measurements, though there is much overlapping in size.

Distribution.—The Andaman Islands.

Nidification.—Osmaston obtained a fine series of the nests and eggs of this Rail in 1907, whilst Wickham and Anderson obtained

others later. All these nests appear to have been made of dead leaves, grass and rushes and to have been placed on the ground in marshy land or on the borders of streams in dense forest. In one case only does the record show that the nest was placed on a thick bush above the ground at a height of some three feet.

The nests contained 3 to 5 eggs of the same texture and colour as those of the other *Rallinas* but the chalky covering with its shiny yellowish surface is perhaps rather more pronounced. Thirty-two eggs average 40·6 × 30·8 mm.; *Maxima 43·1* × 30·8 and 41·3 × *32·0* mm.; *Minima 37·2* × 30·0 and 39·4 × *29·7* mm.

Habits.—There is nothing on record about this Rail beyond Wimberly's remarks of nearly 50 years ago :—

> 'This is an extremely shy, and, I believe, exclusively a forest bird. It certainly never leaves cover during the daytime. It is found either in the forest itself or in thick secondary scrub adjoining this, and especially where the ground is swampy or intersected by hill streams.
>
> 'If driven out of cover it will not take wing unless hard-pressed, when its flight is slow and heavy.
>
> 'Its food appears to consist of insects and fresh-water fish. The latter I infer, as some of those I sent you were taken in snares laid on the ground baited with fresh-water shrimps which were all eaten.
>
> 'I have never heard the call notes, but the man I employed to snare some of my specimens tells me that its call is very similar to that of the Andamanese Banded Rail.'

Later Osmaston endorsed all the above marks and he has also proved it to be a very common bird in the Andaman Islands.

(*To be continued*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., Ph.D., F.L.S.

PART III

(*Continued from page 917 of Vol. xxxi*)

GRAMINEÆ (Cke. ii, 907)

BY

E. BLATTER AND C. MCCANN

We have decided to take up the *Gramineæ* for several reasons. Since Cooke's publication of this family several new species have been described and McCann has added over 50 species which are new to the Presidency. More important than the numerical additions are the changes made during the last fifteen years with regard to the general arrangement of the grasses and the definition of certain genera. A great amount of work has been done in Europe as well as in America. In Europe it was chiefly O. Stapf who, with his vast experience of the grass-flora of many countries and the rich material of the Kew Herbarium at his disposal, has advanced our knowledge of the grasses and their systematic co-ordination more than anybody else. A comparison of his monograph of the grasses in the Flora of Tropical Africa which is still in progress with that of the Flora Capensis shows at once in which direction and to what extent progress has been made. As regards the second subfamily *Pooideæ* the two works reveal only minor changes; but considerable changes were found necessary in the first subfamily *Panicoideæ*. Here again it is chiefly the genera *Andropogon* and *Panicum* and their allies which have been affected. In this respect, especially where the tribe of *Paniceæ* is concerned, we owe a good deal to American botanists. It was chiefly the fact that there were no definite dividing lines for the genera of *Andprogoneæ* and *Paniceæ*, that induced Stapf not 'to unite the groups wherever intermediate links can be detected,' which would bring about endless confusion, but 'to be satisfied with approximately definable groups, which can on the whole be easily grasped and remembered.' In other words, it is preferable from a practical point of view to adopt smaller genera than unmanageable large genera for merely theoretical reasons. As the Kew Herbarium, as far as the grasses are concerned, owes its systematic arrangement entirely to Stapf, and as colonial workers will always appeal to Kew in their difficulties, we thought it advisable to follow Stapf in the definition and sequence of the tribes as laid down in the Flora of Tropical Africa. As of late the grass-problems have received renewed attention by the Agricultural Departments in India, we do not consider it superfluous to bring the systematic account of the grasses of Bombay up-to-date.

An asterisk in front of a name means that the particular genus or species has been introduced.

Two complete keys, one natural and one artificial will be given at the end.

SUBFAMILY I. PANICOIDEÆ

The mature spikelets fall entire from their pedicels or with them, all are alike or differ in sex and structure. Perfect spikelets with 2 heteromorphous florets, the upper hermaphrodite, the lower male or barren. Rhachilla not continued beyond the upper floret.

TRIBE I. *Mayideæ*.—Sexes borne on different inflorescences on the same plant or the female spikelets at the base of the inflorescence, and the male above them. The male spikelets in pairs, one sessile, the other pedicelled, or both pedicelled, in spike-like solitary or panicled racemes, 2-flowered. Glumes

membranous or chartaceous, enclosing the florets. Valves more or less hyaline, awnless. The female spikelets solitary with or without a rudimentary pedicelled companion, 1-flowered. Glumes firm, at least the lower which ultimately often becomes bony, or both thin and more or less hyaline. Valves hyaline awnless.

1. Male and female spikelets in separate inflorescences.
   Male spikelets in a large terminal panicle. The female spikelets in the axils of the leaves
   (*a*) Female spikes distinct, articulated ... ... *1. *Euchlæna.*
   (*b*) Female spikes grown together into a spongy more or less cylindrical body ... ... *2. *Zea.*
2. Male and female spikelets in separate portions of the same spike, the female below.
   (*a*) Grain enclosed in the usually globose or ovoid ivory-like capsuliform supporting sheath ... 3. *Coix.*
   (*b*) Grain enclosed in the hardened outer glumes ... 4. *Polytoca.*

*1. Euchlæna, Schrad.

Stout and tall annuals with leaves very broadly linear or oblong. Male spikelets 2-nate (sessile and pedicellate) on the spiciform fascicled branches of a terminal panicle, 2-flowered with coriaceous glumes. Female spikelets in 2-ranked spikes which are clustered in the leaf-axils, not fused as in the Maize joints rhomboidal, oblique, articulate, excavate, with the margins of the excavation embracing the cartilaginous outer glume and with it forming a smooth pseudocarp.

*1. **Euchlæna mexicana,** Schrad. Ind. Sem. Hort. Götting. (1832), var *luxurians ;* H.H. Mann in Bull. 77, Dept. of Agric., Bombay.—*Reana luxurians,* Dur. in Bull. Soc. Acclim. Sér. II, IX (1872), 581.

Vern. name : Teosinte.

Description : A large, very succulent, strong growing, annual grass, 30 cm.–3 m. high. Leaves long, 5–7·5 cm. broad. Male spikelets 8–9 mm. long, crowded in long spikes in a corymb 15–25 cm. long. Female spikes in the leaf-axils. Styles very long, protruding from the top of the enclosing leaf-sheath. The spike of the female spikelets breaking up at maturity into rhomboidal seed-like joints. Nearly allied to Maize and resembling it in its tassel of male flowers and broad leaves. A single plant often sends up 100 stems.

Locality : Cultivated in the Ganeshkhind Botanic Garden.

Distribution : A native of Guatemala.

Uses : Cultivated for green fodder, but it does not stand drought well. Horses are fond of it.

*2. Zea, Linn. (Cke. ii, 1051, Stapf. Fl. Trop. Afr. ix, 26)

Tall, stout, annual grasses with large leaves, the axils of the lower bearing the female inflorescences (cobs), tightly enveloped by large membranous bracts. Sexes in different inflorescences on the same plant. Male inflorescence terminal, of panicled spike-like racemes with 2-nate spikelets shortly unequally pedicelled or one sessile on the inarticulate rhachis, both similar, 2-flowered, awnless. Glumes subequal, membranous, convex, obscurely 2-keeled, 9–10-nerved. Valves more or less hyaline, 3–5-nerved ; valvules similar, 2-nerved, obscurely keeled ; lodicules 2, fleshy. Stamens 3 ; anthers linear. Female spikelets 2-nate in 4–11 longitudinal rows, slightly immersed in the spongy axis of the cob, with a lower barren and an upper fertile floret, awnless. Glumes similar, very broad, fleshy below, hyaline above, nerveless, ciliate. Lower valve resembling the glumes, but shorter and ciliate, with or without a similar but smaller valvule ; upper valve similar to the lower with a valvule about as long as the ovary. Lodicules 0. Ovary obliquely ovoid. Style very long, 2-fid at the tip, papillose upwards, exserted in long silky tassels from the sheathing bracts. Grain large, subglobose or dorsally more or less flattened, surrounded by the dried up glumes, valves and valvules ; scutellum large, equalling or exceeding $\frac{2}{3}$ of the grain.

Species 1.—A native of America.

*1. **Zea mays,** Linn. Sp. pl. ed. I, 971 ; Beauv. Agrost. 136, t. 24, fig. 3 ; Steud. Syn. Pl. Glum. I, 9 ; Bentl. and Trim. Med. Pl. t. 296 ; Duthie, Field and

Gard. Crops 25, t. 5; Koern. and Wern. Handb. d. Getreidebaues I, 330-378, II, 772-870; Harshberger, Maize, in Contrib. Lab. Univ. Pensylv. I (1893), 75-202; Nicholls, Text-book Trop. Agr. (1892), 260-265; Montgomery, Corn Crops (1913), 1-275; Davy, Maize (1914); Stapf. in Fl. Trop. Afr. IX, 26.

Vern. Names : Maize, Buta, Maka.

Description : Culms up to 3 m. high, sometimes more. Leaf-sheaths terete, more or less hairy upwards along the margin; ligule short, truncate, thinly membranous, more or less pubescent; blades linear-lanceolate, up to over 90 cm. long and 10 cm. wide, glabrous or almost so, tips often drooping. Male panicle up to over 20 cm. long; rhachis pubescent; spikelets up to 12 mm. long; anthers 6 mm. long Female spike (cob) and grains varying much in size and shape, the grains also in colour.

Locality : Cultivated widely in the Presidency as a forage for cattle and as a vegetable and for flour.

Origin : The origin of Maize is a much discussed question. Some are of opinion that it has been developed from Teosinte (*Euchlæna*), others that the original wild form has become extinct. A more acceptable opinion is that it is a hybrid between Teosinte and an unknown or extinct species resembling pod-corn, a variety of *Zea mays* in which each kernel is enveloped in the elongated floral bracts.[1]

Kuwada[2] who studied the number of chromosomes in Maize came to the conclusion that *Zea mays* was originally derived from the hybridization between *Euchlæna* and some unknown species of the tribe *Andropogoneæ*, long chromosomes belonging to the former and short ones to the latter, and that the nuclei of its various individuals possess both kinds of chromosomes in various combinations according to the law of chance.

To explain the structure of the ear of Maize, Collins published evidence which indicated that the ear may have developed through the twisting of yoked pairs of spikelets. Weatherwax[3] tries to refute this opinion. He contends that dropping of rows of seeds is due to the discontinuance of a row of paired spikelets and not to the loss of the pedicelled spikelets from yoked pairs, and that there is no indication that short rows represent long rows partially aborted, but that the abortion of spikelets or of rows in the ear seems to be much more constant as a characteristic of theories than of real ears.

Genetics of Maize : Those interested in Maize from a genetic point of view are referred to the more recent publications mentioned in the foot-note.[4]

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[1] Collins. The origin of maize. Journal Wash. Acad. Sci. 2 (1912), 520.

[2] Kuwada, Y. Die Chromosomenzahl von *Zea mays* L. Ein Beitrag zur Hypothese der Individualität der Chromosomen und zur Frage über die Herkunft von *Zea mays* L. Jour. Coll. Sci. Imperial Univ. Tokyo, 39 (1919), 1-148.

[3] Weatherwax, P. A misconception as to the structure of the ear of maize. Bull. Torrey Bot. Club, 47 (1920), 359-362.

[4] Blaringhem, L.—Production par traumatism d'une forme nouvelle de Mais à caryopses multiples, *Zea Mays* var. *Polysperma*. Compt. Rend. Acad. Sci. Paris 170, (1920), 677-679.

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Kempton, J. H.—Heritable characters of maize. Jour. Heredity, 11 (1920), 111-115.

3. Coix, Linn. (Cke. ii, 997).

Species 5 or 6.—Hot countries of the Old World.

Coix Lacryma-Jobi, Linn. Sp. Pl. ed. i, 972 ; Cke. ii, 997 ; Stapf in Fl. Trop. Afr. ix, 27.—*Coix Lacryma*, Linn. Syst. ed. x, 1261 ; Duthie, Grasses of N. W. India, 11, and Fodder Grass, N. Ind. 18.

Locality: Sind : Umarkot, sandy plains (Sabnis B717 !) ; Chuar Chemali, Indus River (Blatter and McCann D680 !) ; Mirpur Sakro (Blatter and McCann D681 ! D683 !) ; Gharo (Blatter and McCann D682 !).—*Gujarat :* (Graham).—*Khandesh* (McCann !) —*Konkan :* Gokhiwara, Bassein (Ryan 25 !) ; Matheran (Paranjpe !) ; Dohe Forests (Ryan 713 !) ; Junga Hill, Thana (Paranjpe !) ; Alibag, rice fields (Ezekiel !) ; Kenery Caves, foot (McCann 9876 !) ; Sion (McCann 8453 !) ; Bhandup, near tank (McCann 5098 !) ; Horse-shoe Valley, Ghatkoper (McCann 9877 !) : Common along line from Kalyan to Kasara in streams (McCann !).—*Deccan :* Lonavla (Garade ! McCann ! Woodrow) ; Khandala, common all over (McCann 9405 !); Purandhar (McCann 5005 !) ; Igatpuri (McCann 4346 !) ; Panchgani Ghat (Cooke) ; Panchgani (Blatter !).—*S. M. Country :* Devaryi (Sedgwick and Bell 4426 !) ; Dharwar (Sedgwick 1856 !).—*Kanara :* (McCann !) ; Common all through the Konkan and Deccan during the rains, filling up the banks of streams and fields.

Distribution : Tropical Asia, cultivated in Africa and America.

Uses : Used as fodder for cattle. Duthie says that they fatten on it. Haines calls it a poor fodder for cattle. Of the false fruits there are several varieties differing much in size, shape and colour, and used for decorative purposes in the place of beads. According to Stapf one variety with thin shells is an important cereal in Burma and in the Farther East. Waxy endosperm, first found in maize from China, Burma and the Phillippines, has been found now in *Coix Lacryma-Jobi* from the same region.[1]

4. Polytoca, Br. (Cke. ii, 998)

1. **Polytoca Cookii**, Stapf in Hook. Ic. Pl. 24 (1895) t. 2333 ; Cke. ii, 998.

Locality : Kathiawar : Junagad (Blatter). — *Konkan :* Tungar forest, Bassein (Bhide) ; Bombay (Dalzell) ; Salsette (Jacquemont 706). *Deccan :* Khandala (McCann 9881!) ; Igatpuri (McCann 9880!) ; near Mahableshwar (Woodrow[1]) ; Mahableshwar (Woodrow, Cooke). *Kanara :* (Lisboa).

Distribution : Apparently endemic in the Bombay Presidency.

2. **Polytoca barbata**, Stapf in Hook. f. F. B. I. vii (1896), 102 ; Cke. ii, 599. *Coix barbata*, Roxb. Fl. Ind. iii, 569 ; Dalz. and Gibs. Bombay Fl. 289. *Coix gigantea*, Herb. Russ. ex Wall Cat. No. 8626.—*Chionachne barbata*, Br. in Benn. Pl. Rar. Jav. 18 ; Aitchis, Cat. Panj. Pl. 157 ; Duthie Grass. N. W. Ind. 11, and Fodd. Grass. N. India, 19.

Locality : Gujarat : Chharodi farm (Gammie 16536 !) ; Nadiad farm (Herb. Econ. Bot. Poona!) ; Surat (Sedgwick !) ; Junagad, Kathiawar (Blatter 3784 !). *Khandesh :* Toranmal (McCann 9883 !) ; Taloda (Golne!). *Konkan :* Between Worli Fort and Hornby-Villard Road on bank, Bombay (Sabnis 9884 !) ; Thana (McCann !). *Deccan :* High hills round Junnar, Poona District (Dalzell and Gibson) ; Poona (Woodrow) ; College of Science, Poona (Herb. Econ. Bot. Poona !) ; Ganeshkhind Bot. Gard. (Herb. Econ. Bot. Poona !) ; Haveli (Herb. Econ. Bot. Poona !) ; near Sholapur (Woodrow !). *S. M. Country :* S. W. of Dharwar (Sedgwick and Bell 4433 !) ; Kunemelihalli (Sedgwick 1947 !) ; Kholapur (Woodrow !, Herb. Econ. Bot. Poona !). *Kanara :* Gersoppa Falls (Talbot !).

Distribution : India, Ceylon, Java.

Kempton J. H.—Linkage between brachytic culms and pericarp and cob color in maize. Jour. Washington Ac. Sc. 11 (1920), 13-20.

Kempton, J. H.—A brachytic variation in maize. U. S. Dept. Agr. Bul. 925 (1921).

Richey, F. D.—The inequality of reciprocal corn crosses. Jour. Amer. Soc. Agron. 12 (1920), 186-196.

Urbain, A.—Influence des matières de réserve de l'albumen de la graine sur le development de l'embryon. Rév. Gén. Bot. 32 (1920), 125-139, 165-191.

[1] Kempton, J. H. Waxy endosperm in *Coix* and *sorghum*. Jour. Heredity, 12 (1921), 396-400.

Tribe II. *Andropogoneæ.*—Spikelets usually in pairs, one sessile, the other pedicelled, very rarely both pedicelled, those of each pair usually alike as to sex (homogamous) or different (heterogamous) on the axes of variously arranged, often spike-like racemes. Glumes more or less rigid and firmer than the valves, and the lower always longer than the florets. Valves membranous, often hyaline, that of the upper floret awned or reduced to an awn or muticous.

The key to the genera of this tribe will be given below.

5. Dimeria, R. Br.

Woodrowia diandra, Stapf. must be referred to this genus. The genus *Woodrowia*, therefore, disappears from the Bombay Flora.

I. Spikelets in 2–3-nate racemes. Annuals
   (*a*) Rhachis nearly straight. Awn long..... 1. *D. ornithopoda.*
   (*b*) Rhachis circinately curved. Awn short..... 2. *D. Woodrowii.*
II. Spikelets in many-nate racemes. Perennial..... 3. *D. gracilis.*
III. Spikelets in panicles. Annual..... 4. *D. diandra.*

The species of this genus usually inhabit open, flat, dry, gravelly plains which are well drained during the monsoon, and several species may be found associated with each other in the same locality to the exclusion of every other plant. Where *D. ornithopoda*, *gracilis* and *diandra* grow together, the two former are more numerous.

1. **Dimeria ornithopoda,** Trin. Fund. Agrost. (1820), 167, t 14 ; Hack. Monogr. Androp. 81 ; Hook. f. in F. B. I. vii, 104 ; Cke. ii, 945.—*D. filiformis*, Hochst. in Hohenack. Pl. Ind. Or. no. 231.—*Andropogon filiformis*, Roxb Fl. Ind. i. 256.—*Andropogon Roxburghianus*, Schult. Mant. ii, 451.—*Psilostachys filiformis*, Dalz. and Gibs. Bomb. Fl. 305.

Description : Cke. l.c.

Locality : Konkan : Kankeshwar Hills, Alibag (Bhide !) ; Marmagoa (Talbot !) ; Vetora (Sabnis 33715!).—*Deccan :* Mahableshwar (Dalzell and Gibson, Lisboa) ; Lingmala to Mahableshwar, 4,000 ft., rain 200 inch. (Sedgwick and Bell 4653 !); Lonavla (Bhide !, Lisboa) ; Khandala, Tata's Lake, very common (McCann A309 !, 9885 !, Woodrow) ; Sakhar-Pathar, Lonavla (Gammie 15948 !) ; Panchgani (Blatter and Hallberg B1214 !, B1219 !, B1279 !, B1289 !, Woodrow).—*S. M. Country :* Castle Rock (Bhide !), Londa (Woodrow !).—*Kanara :* Yellapore (Sedgwick 3124 !) ; Birchy (Talbot 2251 !) ; Karwar (Hallberg and McCann A307 !) ; Siddhapur to Sirsi, open grass land (Hallberg and McCann A313 !) ; Jagalbet, N. Kanara (Talbot 1565).

Distribution : All over India, Malay Islands, Japan, Tropical Australia.

2. **Dimeria Woodrowii,** Stapf in Hook. Ic. Pl. 24 (1895), t. 2312 ; Hook. f. in F. B. I. vii, 104 ; Cke. ii, 945.

Description : Cke. l.c.

Locality : Konkan : Marmagoa (McCann !, Bhide !, Talbot 2557) ; Karanjee, Ratnagiri Dist. (Herb. Econ. Bot. Poona !) ; Ratnagiri (Herb. Dhura !, Woodrow).—*Kanara :* Mirjan (Hallberg and McCann !) ; Honavar, open rocks (McCann !).

Distribution : W. Peninsula.

3. **Dimeria gracilis,** Nees ex Steud. Syn. Gram. 413 ; Hack. Monogr. Androp. 88 ; Hook. f. in F. B. I. vii, 105 ; Cke. ii, 946.

Description : Cke. l.c.

Locality : Konkan : Penn, hills (Bhide !) ; Vetora (Sabnis 3714 !).—*Deccan :* Lonavla (Bhide !, Woodrow) ; Khandala (McCann A318 !) ; on the Ghats (Lisboa !).—*S. M. Country :* Castle Rock (Bhide !) ; Anmod to Castle Rock (Sedgwick 3254 !).—*Kanara :* Bell and Sedgwick 3165 ! ; Supa (Sedgwick and Bell 4880 !) ; Arbail Ghat (Sedgwick and Bell 5018 !) ; Sirsi (Gammie !) ; Kumwada (Talbot 2260 !) ; Yellapore (Talbot 1527 !) ; Kadra (Talbot !) ; Sumpkhund (Hallberg and McCann A308 !) ; Sirsi to Siddhapur (Hallberg and McCann A311 !) ; Devimani (Talbot !).

Distribution : W. Peninsula, Ceylon.

Where this species is growing together with other species of *Dimeria* it can easily be recognized by its overtowering the others.

4. Dimeria diandra, Stapf in Bhide, New and revised spec. of Gram. from Bombay Jour. and Proc. As. Soc. Bengal, new s. vii, (1911), 515.—*Woodrowia diandra*, Stapf in Hook. Ic. Pl. (1896), t. 2447 ; Hook. f. in F. B. I. vii, 241 ; Cke. ii. 1012.

Description : Cke. l.c. except for the number and description of the glumes, this part of the diagnosis must read like this : Glumes 4 : Lower involucral glume more or less dorsally hairy, with ciliolate margins ; upper involucral glume with a densely ciliate keel ; lower floral glume obovate-oblong, hyaline, nerveless ; upper floral glume 2-lobed, with a geniculate awn about 12 mm. long from the sinus, column of awn 4 mm. long, spirally ciliate, brown, the upper part of the awn yellow, longer than the column.

Locality : Konkan : Vasco da Gama (Bhide !) ; Marmagoa (Talbot 2557 !)—*Deccan :* Khandala, open grass land (Saxton and Bhide !, McCann A317 !).—*S. M. Country :* Castle Rock (Bhide !).—*Kanara :* Kumberwada (Talbot 2261 !) ; Kadra (Talbot 2822 !) ; Devimani (Talbot 3547 !) ; Jog to Siddahapur, open grass land, rocky soil (Hallberg and McCann A314 !) ; Mirjan (Hallberg and McCann A315 !).

Distribution : W. Peninsula.

6. Ischæmum, Linn. (Cke. ii, 957)

Species about 50.—All belonging to the Old World, except 3 found in tropical America.

Cooke, l. c. describes 12 species. Of these *Ischæmum angustifolium* has to go under *Pollinidium* and *Ischæmum laxum, sulcatum* and *spathiflorum* under *Schima*. Instead 3 species new to the Presidency will be added to the genus *Ischæmum*, viz. *I. impressum*, Hack., *I. conjugatum*, Roxb. and *I. timorense*, Kth.

In *Ischæmum* the racemes are geminate or digitate.

A. Margins of lower involucral glume of sessile spikelet inflexed or incurved from base to apex.
  I. Leaves rounded at the base (slightly cordate in *I. molle*), sessile on the sheath.
    1. Pedicel of upper spikelet less than 1/3 the length of the lower spikelet.
      (*a*) Lower involucral glume of sessile spikelets with nodulose margins ... 1. *I. aristatum.*
      (*b*) Lower involucral glume of sessile spikelets closely transversely ribbed ... 2. *I. rugosum.*
      (*c*) Lower involucral glume of sessile spikelets dorsally villous all over, not transversely ridged nor with nodulose margins ... ... 3. *I. molle.*
    2. Pedicel of upper spikelet 1/3 the length of the lower spikelet or more.
      (*a*) Upper involucral glume of sessile spikelets 2-fid, 3-nerved ... ... 4. *I. diplopogon.*
      (*b*) Upper involucral glume of sessile spikelets acuminate, 5-nerved ... ... 5. *I. pilosum.*
  II. Leaves hastate or cordate at the base, often petioled.
    1. Pedicel of upper spikelet not 1/3 of the lower spikelet.
      (*a*) Leaves 7·5—13 cm. long ... ... 6. *I. semisagittatum.*
      (*b*) Leaves 25—35 cm. long ... ... 7. *I. conjugatum.*
    2. Pedicel of upper spikelets as long as the lower spikelet, or longer ... ... 8. *I. impressum.*

B. Margins of lower involucral glume of sessile spikelets broadly incurved below the middle.
  I. Keel of upper involucral glume winged above the middle.
    1. Sessile spikelets 3 mm. long ; callus large, glabrous ; awn 4 mm. long... ... 9. *I. Lisboæ.*
    2. Sessile spikelets 5 mm. long ; callus short, bearded ; awn 12 mm. long ... 10. *I. ciliare.*
  II. Keel of upper involucral glume not winged. 11. *I. timorens.*

1. **Ischæmum aristatum,** Linn. Sp. Pl. (1753), 1049 ; Cke. ii, 958 ; Ranag Achariyar, South Ind. Grass. (1921), 151.

Description : Cke. l. c.

This grass is a very variable one, so variable, indeed, that it is almost impossible to distinguish good varieties, in spite of Hackel's and Hook. f.'s efforts.

Locality : Khandesh : W. Khandesh (Blatter !).—*Konkan :* Bassein (McCann 4474 !) ; Sion Bombay (McCann 5233 !) ; Bhandup (McCann 9899 !) ; Parsik, railway line (McCann 9901 !) ; Matunga near Bombay (Woodrow 4). *Deccan :* Khandala, on rocks (McCann 9908 !); Lohagad, half way up (McCann 9906 !) ; Deolali (Blatter and Hallberg 4554 !) ; Igatpuri (Blatter and Hallberg 5169 !) ; Mahableshwar (Talbot 4534 !) ; Lonavla (Garade !) ; Panchgani (Blatter and Hallberg B1216 !) ; Pasarni Ghat (Blatter and Hallberg B1307 !).—*S. M. Country :* Devarayi (Sedgwick and Bell 4456 !) ; Castle Rock (Bhide !) ; Belgaum (Ritchie 812/2).

Distribution : India (also on higher hills), Ceylon, China, Malaya.

2. **Ischæmum rugosum,** Salisb. Ic. Stirp. Rar. (1791), 1, t. 1 ; Roxb. Fl. Ind. I, 320 ; Hack. Monogr. Androp. 206 ; Duthie Grass. N.W. Ind. 18, and Fodd. Grass. N. Ind. 31 ; F. B. I. VII, 127 ; Cke. ii, 959 ; Ranga Achariyar, South Ind. Grass. (1921), 153 ; Haines Bot. Bihar and Orissa pt. V (1925), 1021.

Locality : Konkan : Bombay Island (Blatter !) ; Kankeshwar Hills, Alibag (Bhide !) ; Bassein (McCann 4479 !).—*Deccan :* Khandala, common, Echo-Point in a dry pool (McCann 9903 !) ; Igatpuri, common (McCann 4348 !) ! Poona (Woodrow).—*Kanara :* Halyal (Talbot 2140 !).

Distribution : India, Ceylon, China, Malaya.

3. **Ischæmum molle,** Hook. f. in F.B.I. vii (1896), 128 ; Cke. ii, 959.

Locality : Konkan : Sion creek (Sabnis 9900 !).—*Deccan :* Lonavla (Bhide ! Woodrow), Igatpuri (McCann 9543 !); Khandala, railway line (McCann 9944!).

Distribution : W. Peninsula, Central Provinces.

4. **Ischæmum diplopogon,** Hook. f. in F.B.I. vii (1896), 129 ; Cke. ii, 960.

Locality : Konkan : Matheran (Woodrow).—*Deccan :* Mahableshwar (Woodrow 4) : Mahableshwar, wet rocks in a stream (Sedgwick and Bell 4595 !] ; Amberwadi, Nasik District (Patwardhan !) ; Sakar Pathar, Lonavla (Gammie 15963 !) ; Khandala (McCann !) ; Bhorkas near Poona (Woodrow 3 !).

Distribution : W. Peninsula.

5. **Ischæmum pilosum,** Hack. Monogr. Androp. 240 ; Duthie Fodd. Grass N. India 31 ; Cke. ii, 961.

Vern. Names : Khavo (Broach), Kunda (Poona), Nuth, Kanigyanhullu (Bijapur).

Locality : Gujarat : Surat, roadside (Sedgwick !).—*Khandesh :* (Lisboa) ; Amalner (Blatter and Hallberg 4397 !).—*Deccan :* Ganeshkhind Bot. Gard. Kirkee (Gammie !) ; Mangri, 8 miles E. of Poona (Herb. Econ. Bot. Poona !) ; Yerowda (Herb. Econ. Bot. Poona !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Kirkee (Talbot !) ; Poona (Bhide !) ; Sholapur (Lisboa) ; Satara (Lisboa).—*S. M. Country :* Kunemelihalli (Sedgwick 2138 !) ; Dharwar (Sedgwick and Bell 5341 !) ; black soil field, Haveri (Talbot 2185 !) ; Gadag (Talbot 2185 !) ; black soil field, 7 miles S. of Hubli (Sedgwick 5341 !).

Distribution : W. Peninsula, Central Provinces, Rajputana.

6. **Ischæmum semisagittatum,** Roxb. Hort. Beng. (1814), 8 ; Hack. Monogr. Androp. 208 : Cke. ii, 961.

Locality : Khandesh : W. Khandesh (McCann !).—*Konkan :* Kenery Caves (McCann 9,914 !) ; Sion, Bombay (McCann 5,251 !) ; Bassein (McCann 4482 !) ; Sewri, Bombay (McCann 3586 !) ; Marmagoa (Talbot 2560 !) ; Parel, Bombay (Woodrow) ; Thana (Lisboa).—*Deccan :* Mahableshwar, in forests (Sedgwick and Bell 4802 !) ; Lonavla (Bhide ! Woodrow) ; Khandala, very common (McCann 9613 !) ; Igatpuri, very common (McCann 4319 !) ; Satara (Lisboa).—*S. M. Country :* Castle Rock (Bhide !); Dudsagar Falls (McCann !).—*Kanara:* Anmod (Sedgwick 3273 !) ; Supa (Talbot 2092 !) ; Jugglepet (Talbot 2089 !) ; Yellapur (Talbot, 738). A very common grass growing usually in the shade of trees. It is common throughout the S. part of the Presidency.

Distribution : Bengal, W. Peninsula, Ceylon.
Var. **dasyantha,** Hack. Monogr. Androp. (1889). 209 ; Cke. ii, 962.
Locality : Konkan (Stocks ex. Cke.).—*Kanara* (Woodrow !)

7. **Ischæmum conjugatum,** Roxb. Fl. Ind. i, 321 (not of Roxb. Hort. Beng. (1894), 8) ; Hack. Monogr. Androp. 205 ; F. B. I. vii, 131. *Spodiopogon conjugatus,* Voigt. Hort. Suburb. Calc. 706 —*Andropogon cordatifolius,* Steud. Syn. Gram. 376.

Description : An annual. Stem spreading from the root and creeping, then geniculately ascending, 30-35 cm. high, slender, stiff, purplish, repeatedly branching upwards. Leaves short, 25–35 mm. long, base hastate or broadly, deeply cordate, acuminate, broadest at the base, rather rigid, striate, lower petioled ; sheath of the upper ventricose and often open ; ligule short, glabrous. Spikes 2, short, 25–35 mm. long, sessile, villous ; joints very short, quadrately clavate, plano-convex, ciliate. Sessile spikelets 3 mm. long, pale. Glumes 4. Lower involucral glume oblong, obtuse, flat, 2-toothed, villous from below or above the middle to nearly the top, margins narrowly inflexed, not winged, upper half often greener, even or lower margins obscurely nodose. Upper involucral glume lanceolate, acuminate, strongly keeled, puberulous. Lower floral glume paleate. Upper floral glume cleft to about the middle, awn dorsally inserted at or below the cleft, slender, about twice as long as the spikelet. Pedicelled spikelets subsessile, almost awnless. Lower involucral glume as in the sessile.

Locality : Konkan : Okda Forest (Ryan, 712 !). *Deccan :* Mahableshwar to Pratabgad (Bhide !) ; Khandala (Garade !) ; College Farm, Poona (Pawar !).—*Kanara :* Gersoppa Falls (Chibber !).

Distribution : Bengal, W. Peninsula, naturalized in Ceylon.

8. **Ischæmum impressum,** Hack. Monogr. Androp. 210 ; F.B.I. vii, 132.

Stem 10–20 cm. high, slender, prostrate below, branching upwards, quite glabrous. Leaves 5–8 cm. long, upper 18 mm. broad, ovate or oblong-lanceolate, cordate, lower narrower, petioled, sparsely hairy beneath, margin thickened, scaberulous, sometimes crenulate ; sheath compressed, glabrous ; ligule oblong. Spikes 2, yellow ; joints and pedicels stout, clavate, ciliate with rigid hairs, forked at the top. Sessile spikelets 6–8 mm. long, shining ; callus short, broad, bearded. Lower involucral glume linear-oblong, flat, dorsally broadly irregularly depressed with shallow subsemilunar pits in the lower 2/3, above it winged and 2-cuspidate, narrowed and margins subnodulose at the base, wings erose. Upper involucral glume obtuse, chartaceous, ciliate, dorsally rounded with a median gibbosity and an auricle-like wing above it. Lower floral glume oblong-lanceolate, hyaline, 3-nerved, ciliate. Upper floral glume much shorter, glabrous, cleft to above the middle, awn short, geniculately inserted at the cleft. Pedicelled spikelets smaller than the sessile. Lower involucral glume obtuse, glabrous, many-nerved, winged on one margin. Upper involucral glume 7-nerved. Upper floral glume mucronate.

Locality : Deccan : Mahableshwar (Sedgwick and Bell, 4514 !); Panchgani, Tableland (Blatter, 5083 !, B1221 !, B1285 !) ; Igatpuri (Blatter !) ; Khandala, Echo-Point (McCann 9943 !) ; Lonavla (Bhide !).

Distribution : We have found this species only in the W. Ghats. Hooker f. mentions the Konkan, but with a sign of interrogation. As we have never met it in the Konkan, it is not likely to occur in that region. Where Huegel's specimen comes from we cannot say, and will in all probability never be known. We think it is quite safe to say that *I. impressum* is endemic in the W. Ghats of the Bombay Presidency.

9. **Ischæmum Lisboæ,** Hook. f. in F.B.I. vii, (1896), 133 ; Cke. ii, 962.

Locality : Kanara : N. Kanara (Lisboa) ; Karwar (Talbot 2209 !, McCann!). A rare grass, apparently endemic in N. Kanara.

10. **Ischæmum ciliare,** Retz. Obs. 6 (1791), 36 ; Hack. Monogr. Androp. 225 ; Duthie Fodd. Grass. N. India. 30 ; Cke. ii, 962. *I. geniculatum,* Roxb. Fl. Ind. I, 322. *S. obliquivalvis,* Nees in Nov. Act. Cur. XIX, Suppl. I (1843), 185 ; Duthie Grass. N. W. Ind. 16.

Locality : Konkan : Bassein (Ryan 445 !) ; St. Xavier's College Comp., Bombay (McCann 4594 !) ; Parel, Bombay (Woodrow) ; Compoli (McCann

9415 !) ; Alibag, sandy shore (Ezekiel !) ; Uran (McCann 5126 !) ; Salsette (Jacquemont 710).—*Deccan:* Khandala, very common (McCann 9612 !); Ganeshkhind Bot. Gard. (Herb. Econ. Bot. Poona !) ; Igatpuri (Blatter and Hall. 3927A !).—*S. M. Country :* Mugad, hill-side (Sedgwick 1823 !) ; Castle Rock (Bhide !).—*N. Kanara :* Yellapore (Talbot 1526 !) ; Halyal, borders of rice fields (Talbot 2141 !)! Ankola (Mamlatdar of Ankola !) ; Karwar, sea coast, sandy soil near Gaol (Talbot 2821 !) ; Gersoppa Falls (McCann !) ; Common throughout Kanara (McCann !) ; Kakti (Woodrow).

Distribution : India, Ceylon, China, Malaya, Australia.

11. **Ischæmum timorense,** Kunth Revis. Gram. i, 369, t. 98 ; Hack. Monogr. Androp. 229 ; F. B. I. vii, 136 :—*I. tenellum*, Roxb. Fl. Ind. i, 323.

Stem 15–45 cm. high, slender, branched, straggling, nodes glabrous, or sparingly bearded. Leaves 2·5–10 cm. long, sessile and petioled, linear-lanceolate, acuminate, glabrous or sparsely hairy, base of upper rounded, of lower rounded ; sheath lax, mouth hairy ; ligule obscure. Spikes 2–3, 25–50 mm. long, rather slender, sparingly villous ; joints and pedicels about half as long as the spikelets, nearly equal, shortly ciliate. Sessile spikelets 2·5–3 mm. long, greenish or with green nerves ; callus narrow, long-bearded. Lower involucral glume ovate or ovate-lanceolate, acuminate, bicuspidate, 5-9-nerved, base ventricose, margins broadly involute below, subauricled, dorsally convex, polished, nerves strong. Upper involucral bracts longer, acuminate or aristulate, dorsally rounded, recurved, 3–5-nerved, tip 2-toothed, dorsally usually ciliate. Lower floral glume lanceolate, falcate, palea linear-oblong. Upper floral glume short, 2-lobed, glabrous, awn in the cleft very slender, shortly exserted. Pedicelled spikelets like the sessile awned.

Locality: Sind: Sukkur (Mamlatdar of Sukkur !).—*Deccan:* Mahableshwar, common (Sedgwick and Bell 4503 !) ; Lonavla (Bhide !) ; Khandala, behind the Saddle (McCann 9915 !).—*S. M. Country :* Deciduous forests W. of Dharwar (Sedgwick and Bell 4500 !) ; Devikop (Sedgwick 2170 !) ; S. W. of Dharwar (Sedgwick and Bell 4429 !) ; Londa (Bhide !).—*Kanara :* Suppa (Talbot 2101 !) ; Yellapore (Talbot 2327 !) ; Dandeli (Talbot 2494 !).

Distribution : Burma, Chittagong, Bengal, Central Provinces, Sind, W. Peninsula, Ceylon, Malaya, Pacific Islands.

7. Thelepogon, Roth. (Cke. ii, 971).

Species 1.—India and tropical Africa.

1. **Thelepogon elegans,** Roth. ex Roem. and Schult. Syst. ii, 788 ; Nov. Pl. Sp. 62 ; Hack. Monogr. Androp. 267 ; F. B. I. vii, 148 ; Cke. ii, 671.—*Andropogon princeps*, A. Rich. Tent. Fl. Abyss. ii, 470, *t.* 102.—*Rhiniachne princeps*, Hochst. ex Steud. Syn. Pl. Glum. i, 360.—*Jardinea abyssinica*, Steud. l.c.—*Rhytachne princeps*, Durand and Schinz. Consp. Fl. Afr. v, 700.

Vern. Names : Bodga (Kaira), Bhatad (Thana), Bangadi (Poona), Pharoda (Ahmednagar).

Description : Cke. l.c.

Locality : Gujarat : Ahmedabad (Sedgwick !) ; Kaira (ex Burns).—*Konkan:* Matheran (D'Almeida A257 !) ; Thana (ex Burns).—*Deccan :* Najar to Pasur Rd. (Paranjpe !) ; Lina Hill, Nasik District (Blatter and Hallberg A79 !, 4544 !) ; Katraj Ghat (Gammie !) ; Bairawadi, Purandhar (McCann 5053 !) ; Panchgani (Blatter and Hall. B1267 !) ; Poona (Woodrow) ; Hewra (Dalzell) ; near Nasik (Edgeworth) ; Ahmednagar (ex Burns).—*S. M. Country :* Dharwar (Sedgwick 1824 !) ; Alnawar (Talbot 2303 !) ; Belgaum (Ritchie 812).—*Kanara :* Halyal (Talbot 2094 !, 2142 !).

Distribution : Central India, W. Peninsula, Tropical Africa.

Uses : Eaten by horses, although very bitter (Dalzell).

8. Sehima, Forsk. Fl. Aegypt.

Arab. 178 ; Stapf. in Fl. Trop. Afr. ix, 35.

Annual or perennial grasses. Blades convolute when young, at length flat, narrow ; ligules a line of stiff hairs. Racemes usually gently curved, dorsiventrally and laterally compressed, with the pedicelled spikelets converging over the convex side, joints and pedicels sublinear and parallel. Sessile and pedicelled spikelets heteromorphous. Spikelets 2-nate, those of each pair

differing in sex, one sessile, the other pedicelled on the articulate fragile rhachis of solitary spike-like racemes, the pedicelled tardily separating from their pedicels, the sessile deciduous together with the adjacent joint of the rhachis and the pedicel. Florets 2 ; lower male, upper bisexual in the sessile, male or neuter in the pedicelled spikelets. Sessile spikelets : glumes equal or subequal ; lower grooved, rarely flat, 2-dentate or 2-mucronate, more or less chartaceous, upwards acutely 2-keeled with inflexed margins, keels winged ; upper glume boat-shaped, keeled upwards with a bristle-like awn. Valves hyaline, of lower floret entire, muticous, of upper 2-fid and awned from the sinus. Valvules more or less equalling their valves, hyaline. Lodicules 2, cuneate. Stamens 3. Stigmas linear-oblong, laterally exserted. Grain oblong, obtusely trigonous ; embryo reaching to the middle of the grain. Pedicelled spikelets flat, with 2 florets resembling the lower floret of the sessile spikelets, the lower or both more or less reduced and barren.

Species about 5.—India, Tropical Africa, N. America.

A. Racemes enclosed in long narrow spathes ... 1. *S. spathiflorum.*

B. Racemes not enclosed in spathes—

I. Sessile spikelets 6-7 mm. long. Lower involucral glume of sessile spikelet 6-nerved ... 2. *S nervosum.*

II. Sessile spikelets 7-11 mm long. Lower involucral glume of sessile spikelet 3–5-nerved ... 3. *S. ischæmoides.*

III. Sessile spikelet 9 mm. long. Lower involucral glume of sessile spikelet 2-nerved ... ... 4. *S. sulcatum.*

1. **Sehima spathiflorum,** nov. comb. Blatter and McCann.—*Ischæmum spathiflorum,* Hook. f. in F. B. I., vii (1896), 138 ; Cke. ii, 963.

Description : Cke. l. c.

Locality : Khandesh : Toranmal (McCann 9922 !).—*Konkan :* Penn (Bhide !) ; Matheran (Paranjpe !) ; Bassein (Ryan 2300 !) ; Kenery Caves (McCann 9920 !) ; Island of Salsette in hilly stony places (Jacquemont 797).—*Deccan :* Lonavla (Bhide !) ; Khandala (Woodrow) ; Khandala, in watercourses, very common (McCann 9928 !) ; Palasdari on the Bhor Ghat, G. I. P. Railway (Woodrow) ; Lohagad, plain (McCann 9919 !) ; Bairawadi, Purandhar (McCann 5054 !) ; Igatpuri (Blatter and Hallberg 3836 !, McCann !).

Distribution : Endemic.

2. **Sehima nervosum,** Stapf. in Fl. Trop. Afr. IX, 36 ; Haines pt. v, 1023.—*S. macrostachyum,* Hochst. in Schimp. Pl. Abyss. n. 1705.—*Andropogon nervosus,* Rottl. *apud* Willd. in Verh. Naturf. Fr. Berlin, iv (1803), 218.—*Andropogon striatus,* Klein *apud* Willd. Sp. Pl. iv. (1805), 903 ; R. Br. Prodr. 201.—*A. tacazensis,* Steud. Syn. Pl. Glum. i, 369.—*A. macrostachys,* Anders. in Schweinf. Beitr. Fl. Aeth. 306 (*per errorem* 310).—*Ischæmum laxum,* R. Br. Prodr. 205 ; Hook. f. in F. B. I. vii, 136, *partim ;* Cke. ii, 964, *partim.*—*Ischæmum laxum* var. *genuinum,* Hack. in Monogr. Androp. 245.—*Ischæmum nervosum,* Thw. Enum. Pl. Zeyl. 305.—*Ischæmum macrostachyum,* A. Rich. Tent. Fl. Abyss. ii, 472.—*Pollinia striata,* Spreng. Pug. ii, 12.—*Hologamium nervosum,* Nees in Edinb. N. Phil. Journ. xviii, 185.

Description : A perennial, densely tufted grass. Stems erect, 60 cm. to 1 m. high, on a short rootstock, simple or nearly so, slender, terete, about 4-noded, middle and upper internodes exserted, smooth or slightly rough below the inflorescence, glabrous. Leaves 15-30 cm. and longer, 2–4 mm. broad, erect, linear, narrowed into long capillary tips, flat, smooth, striate, glaucous, more or less scabrid, lateral nerves about 3 on each side, like the midrib whitish and prominent on both sides ; sheaths shorter than the internodes, tight, terete, striate, smooth or nearly so, glabrous or sparingly hirsute from tubercle-based hairs ; ligule a line of short stiff hairs. Racemes solitary, 5–10 cm. long, erect, slightly curved, pale, fragile ; joints and pedicels parallel, sublinear, slightly compressed, 3-4·5 mm. long, densely ciliate with white hairs along the angles, otherwise glabrous, tips more or less oblique. Sessile spikelets lanceolate-linear to linear, acuminate, 6·25–7 mm. long, pale green, with a shortly bearded callus. Glumes subequal: lower subchartaceous to chartaceous, with an unequally 2-toothed, flat and membranous beak, the teeth of which sometimes run out into ciliate mucros, deeply grooved, especially below the middle, acutely 2-keeled, outer keel generally winged upwards, intracarinal nerves 4, with transverse veins in the upper part, like these green and raised on a white

ground ; upper glume subchartaceous, slightly shorter, boat-shaped, sublinear in profile, keeled above, with the keel widened at the apex and passing into a fine bristle 11–12·5 mm. long, 5-nerved with fine transverse veins, ciliate. Lower floret : valve faintly 2-nerved, hyaline, ciliate, 4·5 mm. long, with a narrow, linear valvule of about equal length and a male flower. Upper floret bisexual : valve oblong-lanceolate, 4 mm. long, 2-fid, with narrow lobes, hyaline, 3-nerved, ciliate ; awn up to 43 mm. long. slender, column spirally twisted, bronze colour, very minutely ciliate along the spiral, bristle whitish, as long as the column or slightly longer ; valvule as long as the valve, linear, subacute, 2-nerved, ciliate. Anthers 3 mm. long. Styles and stigmas pale, 2 mm. long. Pedicelled spikelet lanceolate, acuminate, green or tinged with purple, 7–8·5 mm. long, glabrous ; lower glume slightly 2-toothed, long-ciliate from the hairs of the tightly inflexed margin, keels very narrowly or obscurely winged, wing rigidly ciliate, intracarinal nerves 5, the inner 3 very prominent and rough ; upper glume lanceolate, long and finely acuminate, hyaline, ciliate, 3-nerved ; lower floret as in the sessile spikelet ; upper floret very much like the lower. Stamens smaller in the lower floret or both florets reduced and empty.

Locality : Gujarat : Porbandar (Bhide !) ; Junagad, Kathiawar (Blatter 3799 !) ; Surat, city walls (Herb. St. X. C. 9498 !) ; Ahmedabad (Sedgwick !).—*Khandesh :* (Lisboa) ; Umalla village, on Tapti river (Blatter and Hallberg 5160 !) ; Toranmal, common on the slopes (McCann 9916 !).—*Deccan :* Purandhar Fort (Bhide !, McCann 5106 !) ; Khandala, St. X. Villa compound (McCann 9419 !) ; Deolali (Blatter and Hallberg 4548 !) ; Lonavla (Bhide !) ; Panchgani (Blatter and Hallberg B1269 !) ; Poona (Woodrow) ; Poona to Karli (Jacquemont 530).—*S. M. Country :* Dharwar (Bhide !) ; Haveri (Talbot 2186 !).

Distribution : Bengal, Behar, Central Provinces, Rajputana, W. Peninsula, Ceylon, Tropical Australia, Somaliland, Abyssinia, Eritrea. Cape de Verd Islands

Uses : Used for thatching in Khandesh (Lisboa). Considered to be one of the best fodder grasses and is eaten by cattle even after the fall of the spikes (Haines).

3. **Sehima ischæmoides,** Forsk. Fl. Aegypt.—Arab. 178 ; Stapf in Fl. Trop. Afr. IX, 37.—*Sehima Kotschyi,* Hochst. in Flora (1844), 247.—*Ischæmum Sehima,* R. Br. Prodr. I, 204.—*Ischæmum inscalptum,* Hochst. in Schimp. Pl. Abyss. n. 739 and Flora (1844), 247 ; A. Rich. Tent. Fl. Abyss. II, 472.—*Andropogon Sehima,* Steud. Syn. Pl. Glum. I, 369.—*Andropogon lineatus,* Steud. l.c.—*Andropogon schangulensis,* Rupr. ex. Steud. l.c.—*Andropogon inscalptus,* Anders. in Schweinf. Beitr. Fl. Aeth. 306 (*per errorem* 310).—*Ischæmum laxum,* R. Br. Prodr. (1810), 205 ; Hook. f. in F.B.I., VII, 136, *partim.*—*Ischæmum laxum* var. *inscalptum,* Hack. in Monogr. Androp. 245.—*Andropogon rhynchophorus,* Stapf in Bull. Soc. Bot. Fr. LV (1908) Mem. VIII. 101.

An annual herb. Stems usually in small fascicles, rarely over 45 cm. high, slender, terete, simple, 2- or 3-noded, middle and upper internodes slightly exserted, smooth, glabrous. Leaves glaucous, linear, tapering to a long fine point, up to 13 cm. long, 1·5–3·1 mm. broad, more or less scabrid, midrib fine like the 1 or 2 primary lateral nerves. Racemes solitary, or sometimes an additional 1 or 2 from the upper nodes, 2·5–7·5 cm. long, erect, or slightly nodding ; joints and pedicels parallel, sublinear, slightly compressed, 3·1 mm. long, very densely ciliate from white hairs along the angles, otherwise glabrous, tips more or less oblique. Sessile spikelets linear 7–11 mm. long, pale green, with a shortly bearded callus ; lower glume subchartaceous to chartaceous, with an unequally 2 toothed flat and membranous long beak, the teeth of which run out into mucros, deeply grooved, especially below the middle, acutely 2-keeled, the outer keel generally winged upwards, intracarinal nerves 3–5, raised, rough, only distinct just above the groove ; upper glume and florets as in *Sehima nervosum,* excepting the bristle of the glume which is over 15·5 mm. long and the awn, the column of which is generally more brown than bronze in colour and has much longer cilia along the spirals. Pedicelled spikelets narrowly lanceolate, long-acuminate, pale green, up to 12·5 mm. long, glabrous ; lower glume with two long setaceous teeth, sparingly hairy on the back, otherwise the spikelet as in *Sehima nervosum.*

Locality : Deccan (Woodrow 147, Law, ex. Stapf.)

Distribution : Tropical Arabia, Yemen, Abyssinia, Sudan, Kordofan, Nubia, Cameroons, Cape de Verd Islands.

4. **Sehima sulcatum,** comb. nov. Blatter and McCann.—*Ischæmum sulcatum,* Hack. in Monogr. Androp. 248 ; Hook. f. in F.B.I., vii, 137 ; Cke. ii, 964.

Description : See Cke. l.c.

Locality : Deccan : Satara (Lisboa) ; Malsiras, Sholapur Taluka (Lisboa).—*S. M. Country :* Black soil banks 35 miles S. of Dharwar (Sedgwick 3745 !) ; banks of black soil fields 7 miles S. of Hubli (Sedgwick and Bell 5342 !) ; Dharwar, common (Sedgwick 1819 !, McCann !).

Distribution : Central Provinces, W. Peninsula.

9. Pollinidium, Stapf.

As far as we can make out the diagnosis of this genus was published for the first time in Haines' Botany of Bihar and Orissa, pt. 5 (1924), 1020.

Densely tufted, perennial herbs with woolly rootstock and basal sheaths. Leaves convolute when old, wiry, mouth of sheaths ciliate. Spikes digitate or fascicled, fascicles with filiform peduncles on a more or less branched panicle. Spikelets 2-nate, sessile and pedicelled, similar, on the articulate, fragile, compressed, not stout rhachis. Callus densely clothed with long brown hairs. Glumes 4 : Lower involucral glume flattened, 2-3-dentate, dorsally hairy at base, 5–7-nerved, margins inflexed ; upper involucral glume cymbiform, minutely cuspidate, 3–5-nerved, with a slender awn. Lower floral glume hyaline, sparsely ciliate, elliptic, palea finely ciliate ; upper floral glume narrow, conduplicate, entire or 2-toothed shortly awned from the tip or minute sinus, palea broad and nearly as long as the glume, densely ciliate on the top.

1. **Pollinidium angustifolium,** Haines Bot. Bihar and Orissa, pt. 5 (1924), 1020.—*Ischæmum angustifolium,* Hack in Monogr. Androp. 241 ; Hook. f. in F.B.I. vii, 129 ; Cke. ii, 960.—*Spodiopogon angustifolius,* Trin. in Mem. Acad. Petersb., ser. VI, ii (1833), 300 ; Spec. Gram. Ic. t. 336.—*Pollinia eriopoda,* Hance in Journ. Bot. iv (1866), 173.– *Andropogon binatus,* Retz. Obs, vi, 21.

Description : Cke. l.c.

Locality : Gujarat : Rajkot (Woodrow).—*Konkan :* Victoria Gardens, Bombay (McCann 4302 !).—*Deccan :* College Garden, Poona (Grade !) ; cultivated at Poona (Woodrow).

Distribution : Afghanistan, India, China, Philippines.

Uses : In Bihar and Orissa the Sabai grass is used for strings, ropes and mats (the Baib matting of Calcutta) and is very largely employed for paper-making. Fires improve the crop by removing shade. It is easily grown by division of the rootstock or from seed. From seed it yields a crop in about three years. Cattle do not eat it (Haines). For Bombay see Cke. l.c.

10. Apocopis, Nees. (Cke. ii, 967)

1. **Apocopis vaginatus,** Hack. in Oestr. Bot. Zeitschr. 41 (1891), 8 ; Cke. ii, 967.—*A. Wightii,* Nees, var. *vaginata,* Hook. f. in F.B.I., vii, 143.

Description : Cke l.c.

Locality : Gujarat : Ahmedabad, field (Sedgwick !).—*Konkan :* Kalyan (Woodrow).—*S. M. Country :* Forests W. of Dharwar (Sedgwick !)—*Kanara :* Halyal (Talbot 2379 !) ; N. Kanara (Woodrow).

Distribution : Bihar, Central India, Deccan and W. Peninsula, Burma, Ceylon.

11. Lophopogon, Hack.

1. **Lophopogon tridentatus,** Hack. in Engl. and Prantl. Nat. Pflanzenf. ii, pt. ii (1887), 22, 56, Monogr. Androp. 254, t. i. f. 14 ; Hook. f. in F.B.I. vii, 149 ; Cke. ii, 966.—*Andropogon tridentatus,* Roxb. Fl. Ind. i, 257.—*Saccharum tridentatum,* Spreng. Syst. i, 283.

Description : Cke. l. c.

Locality : Khandesh : Tapti, Bhusawal (Blatter and Hallberg 5457 !). --*Deccan :* Agricultural College compound, Kirkee (Bhide !) : Bapodi near Poona (Gammie 15315 !) ; Bowadhar near Poona (Garade !) ; Rahuri (Nana A80 !) ; Igatpuri (McCann 4572 !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Deolali (Blatter 9620 !, 9610 !) ; Jeur, Sholapur Dist. (Woodrow !).—*S. M Country :* Dharwar, on dry gravelly uplands 2,400 ft., rain 34 inches (Sedgwick 3010 !).

Distribution · Central Provinces, W. Peninsula.

12. APLUDA, Linn. (Cke. ii, 956)

1. **Apluda varia,** Hack. in Monogr. Androp. 196, var. **aristata,** Hack. l. c. 199 ; Hook. f. in F.B.I., vii, 150 ; Cke. ii, 956, *comprehendens etiam alias varietates* ; Stapf. in Fl. Trop. Afr. ix, 40 ; Haines pt. v, 1057.—*Apluda aristata,* Linn. Cent. ii, 71 ; Schreber Beschr. d. Gr. 93, t. 42 ; Beauv. Agrost 133 ; Duthie Fodd. Grass. of N. Ind. 44, t. 29.—*Apluda Gryllus,* Beauv. Agrost. Explic. planches, 15, t. 23, fig. 5 (6 *per errorem*).

As our Bombay specimens must be referred to the var. *aristata* and as Cooke's description comprises also other varieties we give in the following Stapf's diagnosis of the variety *aristata.* This must not prevent botanists from paying attention to the possible occurrence of other varieties in the Presidency.

Description : Mostly annual, branched from the base. Stems densely tufted, erect, 30–180 cm. high, or geniculately ascending and often rooting from the nodes, many-noded, terete, smooth and polished. Leaves 10–45 cm. by 4–15 mm., linear-lanceolate, long-attenuated towards the base, almost petioled, tapering upwards to a fine setaceous point, convolute in bud, then flat, somewhat rigid or flaccid, glaucous below, glabrous or very rarely sparingly hairy, slightly rough above, scabrid along the margins, midrib white above, stouter towards the base, primary lateral nerves, 5–8 on each side, fine ; sheaths terete, tight and glabrous or very rarely sparingly hairy, those supporting the flowering branches wider and shorter with reduced blades ; ligules short, rounded off, glabrous or ciliate. Panicle upto 60 cm. long, much compound, primary branches long, those of the following orders gradually shorter, bearing clusters of trios of spikelets ; spathe at the base of the trios ovate to ovate-oblong, mucronate or bearing rudimentary blades, glabrous, green or tinged with purple, 4–4·5 mm. long ; bulbous basal joint up to 1·5 mm, long, whitish. Sessile spikelets lanceolate-oblong, acute, up to 4·5 mm. long. Lower involucral glume chartaceous, firmer below, many-nerved ; upper involucral glume somewhat gibbous on the back, scaberulous on the keel. Lower floret : Valve oblong-lanceolate, acute, slightly shorter than the glumes, 3-nerved, glabrous ; valvule linear-lanceolate, almost as long as the valve, 2-nerved. Upper floret : valve 3·1 mm. long, 2-fid to beyond the middle, awn up to 9·3 mm. long, very fine, with or without a distinct twisted column ; valvule generally much shorter, oblong or broad-ovate, nerveless. Anthers 2·3–3·1 mm. long. Stigmas purple, up to 4·5 mm. long. Grain about 1 mm. long, Pedicels 2·3–3·1 mm. long, sparingly ciliate. Lateral pedicelled spikelet 4–5 mm. long. Glumes similar, subherbaceous, lanceolate, acute, many-nerved ; lower glume rather flat on the back, upper not or obscurely keeled and not gibbous. Florets as in the sessile spikelet but the upper not awned, both are male more or less reduced. Terminal spikelet reduced to a short striate glume, continuing the pedicel.

Locality : Gujarat : Broach (Chibber !) ; Nadiad Farm (Herb. Econ. Bot. Poona !) ; Surat (Gammie 16467 !, Cooke) ; Karu Roa, Cutch (Blatter 3776 !) ; Kala Pacham Island (Blatter 3735 !) ; Garvi Dangs (Sedgwick !) ; Ahmedabad (Cooke).—*Khandesh :* Muravat, Tapti bank (Blatter and Hallberg 4434 !) ; N. slope of Chanseli Hill (McCann A83 !) ; Toranmal (McCann A84 !) ; Munmad, Ankai Hill (Blatter A146 !).—*Konkan :* Dhapli forest (Roan !) ; extremely common throughout the islands of Bombay and Salsette (McCann !) ; Bassein (McCann 4480 !) ; Alibag, margin of water-works (Ezekiel !).—*Deccan :* Purandhar (McCann 5008 !, Bhide !); Khandala, very common (McCann 5294 !) ; Diva Ghat (McCann A86 !); Sholapur (D'Almeida A87 !); Igatpuri, very common (McCann 4325 !, 4324 !); Panchgani (Blatter 53–85 !, Bhide !, Blatter and Hallberg B1322 !).—*S. M. Country :* Dharwar (Sedgwick and Bell 4489, 2400 ft., rain 34 inches ; Londa (Gammie 15851 !); Belgaum (Ritchie 824).—*Kanara :* Halyal (Talbot 2495 !); Juggleput (Talbot !); Kawarwad (Talbot 2246 !).

Distribution : Socotra, India, Ceylon, E. Tropical Asia, Malaya, Australia, Pacific Islands.

Uses : A fairly good fodder grass, and readily eaten by cattle when young (Duthie).

13. HEMARTHRIA R. Br. (Stapf in Fl. Trop. Afr. ix, 54)

Decumbent or ascending perennial grasses with branched, many-noded stems. Leaves linear, conduplicate in bud, then flat. Ligules very short, membranous.

Racemes compressed, often curved, tips more or less subulate from the slender terminal spikelet ; rhachis not or tardily breaking up. Spikelets pseudo-opposite owing to the fusion of joints and pedicels, each pair made up of a sessile (secondary) spikelet and the pedicelled companion of the sessile spikelet of the next lower node. Spikelets two-nate on the tough or tardily disarticulating rhachis of spike-like, spathe-supported racemes which terminate the culms and their often fascicled branches, alike in sex and shape, or at least similar ; joints and pedicels fused into roughly semicylindric internodes, hollowed out on the inner face for the reception of the sessile spikelet ; disarticulation at a right angle to the rhachis or slightly oblique, tips of joints truncate, not hollowed out or appendaged. Sessile spikelet : Florets 2, lower reduced to a barren valve, upper bisexual, awnless. Glumes equal or subequal, lower flat on the back, 2-keeled, very narrowly inflexed along the margins, coriaceous or subcoriaceous, closing up the cavity formed by the adjacent joint and pedicel, upper membranous, adhering to the inner face of the cavity. Valves hyaline, of lower floret 2-nerved, of upper usually nerveless. Valvule of upper floret hyaline, small, nerveless. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong, dorsally slightly compressed ; embryo about $\frac{2}{3}$ the length of the grain : hilum conspicuous, punctiform, subbasal. Pedicelled spikelet with more elongated acuminate glumes, especially the terminal, the upper glume mucronate or aristate.

Species about 8. Throughout the warm countries of the Old World, 1 also in America, but probably introduced.

1. **Hemarthria glabra**, comb. nov. Blatter and McCann. *Rottbœllia glabra*, Roxb. Fl. Ind. ed. Carey i, 353. *Hemarthria coromandelina*, Steud. Syn. i, 358. *Rottbœlia compressa*, Linn. f. Suppl. 114, var. *genuina*, Hack. Monogr. Androp. 286 ; Hook. f. in F. B. I. vii, 153. *Rottbœllia compressa*, Linn. f. Suppl. 114, *partim* ; Cke. ii, 952, *partim*. *Hemarthria compressa*, Kunth Enum. i, 465, *partim*.

A word of explanation is required regarding the new name. Haines in his Botany of Bihar and Orissa, pt. VI (1924), 1061, mentions a species under the name of *Hemarthria compressa*, R. Br. and gives as synonym *Rottbœllia compressa*, Linn. f. which, in our opinion, is not correct. *Hemarthria compressa*, R. Br. Prodr. Floræ Novæ Hollandiæ et insulæ Van Diemen, p. 207, represents only partly *Rottbœllia compressa*, Linn. f. Besides, Stapf in. Fl. Trop. Afr. ix, 55 has separated *Rottbœllia compressa*, Linn. f. var. *fasciculata* from the type and described it under the specific name *Hemarthria fasciculata*, Kunth Rev. Gram. i, 153. He was allowed to use this old name, because *Hemarthria fasciculata* is the same plant as Hackel's var. *fasciculata* (Monogr. Androp. 287.) As to the species under consideration, it coincides with Hackel's *Rottbœllia compressa* Linn. var. *genuina*. With this *Hemarthria compressa*, Kunth Enum. i, 465 agrees only partly and this name cannot, therefore, be adopted. There are only two names left which can be considered: *Rottbœllia glabra* and *Hemarthria coromandelina*. Of these the former is the older and should, therefore, be retained, but as the species is being transferred to the genus *Hemarthria*, the plant has to be called *Hemarthria glabra*, nob.

Description : A perennial grass. Stems creeping below, then erect, scandent, 1·5 to 6 m. long (Roxb.). Blade of leaf short, slowly getting narrower upwards, but at the apex slightly obtuse ; sheath at the nodes glabrous. Racemes slender, compressed, 6–10 cm. long, solitary or the upper ones often fascicled. Spikelets 2-nate, 4–4·5 mm. long ; callus 1 mm. long, obconical, obtuse, glabrous. Sessile spikelets : Lower involucral glume broad, ovate lanceolate, obtuse, at the apex emarginate or obtusely bidentate, not in the least acuminate, scarcely constricted below the apex. Pedicelled spikelets : Pedicel adnate. Glumes acute or subacuminate.

Locality : Sind : Bughar, Indus River (Blatter and McCann D661 !) ; Mirpur Sakro (Blatter and McCann D662 !). *Gujarat :* Kankaria Tank, Ahmedabad (Sedgwick !).—*Khandesh :* Tapti, Bhusawal N. E. (Blatter and Hallberg 5495 !).—*Kanara :* Sirsi to Siddhapur (Hallberg and McCann A78 !). We have not included the localities mentioned by Cke. ii, 952 as some of his specimens might belong to another species.

Distribution : We do not know of any definite record as to the distribution of this species. Hooker f. calls it common in India. Hackel gives Bengal, Sarampur, Punjab, Nepal, Ceylon, China. Duthie says it occurs in moist

places in the plains, and at low elevations on the hills of N. India, and extends to Australia. It would apparently be correct to say that this plant is found all over India and Ceylon. We are not so sure about Australia.

The question now arises whether *Hemarthria fasciculata*, Kunth occurs in the Presidency. Wight, Roxburgh, Hook. f. and Duthie mention it for other parts of India and Duthie found it in the same localities where he gathered the previous species, but we have no reliable information at hand to say that it has been found in the Bombay Presidency. In all probability it does occur in our parts. In order to help botanists to clear up this point we add Stapf's description and synonymy of *H. fasciculata*, Kunth. At the same time it will be good to remember what Hackel says under *Rottbœllia compressa*, Linn. f. : '*Species valde polymorpha ; varietates sequentes in speciminibus typicis satis distinctæ, ed et ipsæ ita variabiles, ut nullus earum characterum constans, formæque intermediæ frequentes.*'

Hemarthria fasciculata, Kunth Rev. Gram. i, 153, and Enum. i, 465 ; Hack. in Mart. Fl. Bras. II, iii, 314, t. 72, fig. 2.—*H. capensis*, Trin. Androp. in Mem. Acad. Petersb. 6 me sér. ii, 248.—*Rottbœllia compressa*, Linn. f. var. *fasciculata*. Hack. Monog. Androp. 286 ; Hook. f. in F.B.I. vii, 153 ; *Rottbœllia compressa*, Linn. f. ; Cke. ii, 952, *partim.*—*Rottbœllia fasciculata*, Lam. Illustr. i, 204.—*Lodicularia fasciculata*, Link. Hort. Berol. i, 6.—*Lodicularia capensis*, Nees Fl. Afr. Austr. 128.—*Lepturus fasciculata*, Trin. Fund. Agrost. 123.

Description : A perennial grass. Stems erect or more often ascending, sometimes from a long decumbent rooting base, usually branched, 30 cm. to 1·5 m. high, many-noded, compressed, glabrous. Leaves linear, gradually tapering, acute, very variable in length and width, up to 23 cm. by 4 mm ; sheaths shorter or the lower longer than the internodes, compressed, keeled, often ciliate towards the mouth, otherwise glabrous or almost so ; ligules membranous, very short, ciliate. Racemes usually fascicled, straight or curved, tapering to a slender point formed by the terminal spikelet, ultimately more or less fragile. Sessile spikelet linear-oblong to oblong, from a short obtriangular more or less conspicuous glabrous callus, 4–5·5 mm. long, glabrous. Lower glume coriaceous, opaque, usually more or less constricted below the obtuse entire or emarginate, 2-keeled and very narrowly winged tips, smooth, intracarinal nerves about 7 ; upper broadly oblong-lanceolate, acute, membranous except at the hardened tip, 3-nerved. Lower floret : Valve oblong, subobtuse, distinctly shorter than the glumes, 2-nerved. Upper floret : Valve slightly shorter, ovate-oblong, obtuse, nerveless. Anthers 1·5–2·3 mm. long. Stigmas about 1·5 mm. long, laterally exserted. Grain oblong, dorsally compressed, about 1·5 mm. long, reddish ; scutellum exceeding half the length of the grain ; hilum punctiform, subbasal. Pedicelled spikelet similar in sex and shape to the sessile, but slightly longer, with the lower glume more acuminate and acute, and the upper sharply mucronate, the mucro somewhat exceeding the lower glume.

Distribution : British E. Africa, Mozambique District, throughout Africa in the Mediterranean region (Stapf), India, America, probably introduced.

14. Manisuris, Linn. f.

Species 1.—Throughout the tropics.

1. **Manisuris granularis**, Sw. Prodr. Veg. Ind. Occ. (1788), 25 ; Beauv. Agrost. t. xxi, Fig. 10 ; Roxb. Pl. Corom. ii, 11, t. 118 ; Mart. and Eichl. Fl. Bras. ii, 2, t. 46 ; Hack. Monogr. Androp. 314 ; Duthie Grass. N. W. Ind. 18, Fodd. Grass, N. India. 29, t. 46 ; Hook. f. F.B.I. vii, 159 ; Cke. ii, 955 ; Stapf Fl. Trop. Afr. ix, 57.— *M. polystachya*, Beauv. Fl. Owar. et. Ben. t. 14.—*Cenchrus granularis* Linn. Mant. ii, App. 575.—*Hackelochloa granularis*, O. Ktze. Rev. Gen. Pl. ii, 776.—*Rytilix granularis*, Skeels in U.S. Dept. Agr. Bur. Pl. Industr. Bull. 282 (1913), 20.

Locality : Gujarat : Charodi (Gammie 16534 !).—*Konkan :* Wada Taluka (Ryan 600 !) ; Mulgaum in Salsette, open grass land (McCann 3642 !).—*Deccan :* Poona (Woodrow ! Cooke) ; Deolali (Blatter and Hallberg 4552 !) ; Igatpuri (McCann 4573 !) ; Railway line, Kirkee to Poona (Garade 8231 !) ; Chattar-(hinji Hill, Poona (Ezekiel !) ; Khandala (Woodrow), behind Hotel

(McCann 9410 !), behind Duke's Nose (McCann 9393 !).—*S. M. Country :* Dharwar (Sedgwick and Bell 4146 !, Woodrow), 2,400 ft., rain 34 in.; Kuput Hill, Dharwar District (Talbot 2323 !).—*Kanara :* Halyal (Talbot 1733 !, 2385 !).

15. PELTOPHORUS, Desv. (Stapf Fl. Trop. Afr. ix, 59)

Annual or perennial short grasses with slender, much-branched, rarely simple stems. Leaves linear, narrow, conduplicate in bud, then flat; ligules short, membranous. Racemes much compressed, rather slender, straight or curved, very conspicuously dorsiventral. Spikelets pseudo-opposite owing to the fusion of joints and pedicels, each pair made up of a sessile (secondary) spikelet and the pedicelled companion of the sessile spikelet of the next lower node. Spikelets 2-nate on the rhachis of spike-like, spathe-supported racemes which terminate the stems and their branches, different in sex and shape. Joints and pedicels fused into somewhat stout internodes, convex on the back, hollowed out on the inner face for the reception of the sessile spikelet; disarticulation at a right angle to the rhachis, tips of internodes truncate with two concavities corresponding to the next upper sessile and the adjacent pedicelled spikelet. Sessile spikelet dorsally much compressed. Florets 2, lower male or neuter and then with or without a valvule, upper bisexual, awnless. Glumes equal or the upper shorter; lower coriaceous, transversely rugose or muricate, conspicuously winged from the keels, upper membranous, immersed in the cavity formed by the joint and pedicel, usually 3-nerved, keeled, often indistincly. Valves hyaline, nerveless or 2-3-nerved. Valvule, if present, hyaline, nerveless or 2-nerved. Lodicules 2, cuneate. Stamens 3. Stigmas linear, laterally exserted low down. Grain oblong; embryo equalling the grain. Pedicelled spikelet male or neuter. Lower glume coriaceous, smooth, asymmetrically or unilaterally winged, upper variously winged from the keel. Florets as in the sessile spikelet but male or barren.

Species 5.—India (4) and Tropical Africa (1).

I. Lower involucral glume 2—aristate ... 1. *P. divergens.*
II. Lower involucral glume with a simple awn or acuminate.
  1. Lower involucral glume broadly ovate, acuminate (not awned) ... ... 2. *P. acuminatus.*
  2. Lower involucral glume lanceolate with a slender scabrid awn ... ... 3. *P. Talboti.*

1. **Peltophorus divergens**, comb. nov. Blatter and McCann.

Rottbœllia divergens, Hack. Monogr. Androp. 293; Lisboa in Jour. Bom. Nat. Hist. Soc., vi (1891), 195; Hook. f. in F. B. I., vii, 155; Cke. ii, 953.

Description : Cke. l. c.

Locality : Konkan : Trombay (McCann A71 !).—*Deccan :* Mahableshwar, 4,500 ft., rain 270 inches (Sedgwick and Bell 4560 !, Lisboa); Panchgani (Blatter and Hallberg B1252 !, B1259 !, B1263 !, B1286 !), behind the Tableland on rocks (Blatter 3805 !); Satara (Lisboa); Lonavla (Bhide !); Khandala (Woodrow), Saddle, very common all over (McCann 9616 !).—*S. M. Country :* Amboli Ghat (Talbot 4305 !); Belgaum (Ritchie 808, 827).—*Kanara :* Castle Rock, 1,800 ft., rain 300 inches (Sedgwick and Bell 4295 !), Karwar (Talbot 3171 !).—Usually growing on rocks in tufts.

Note. The spikes are very brittle when dry and always fall off.

Distribution : W. Peninsula.

2. **Peltophorus acuminatus**, comb. nov. Blatter and McCann.

Rottbœllia acuminata, Hack. Monogr. Androp. 291; Hook. f. F B. I. vii, 155; Cke. ii, 953.

Description : Cke. l. c.—We have examined Talbot's specimen No. 1291 and found that the lower involucral glume is much longer than 8 mm. (1/3 in.) going up to 10 and 12 mm.

Locality : Konkan : Marmagoa (Talbot 2572 !, 1291); Vasco da Gama (Herb. St. X. C. 9483 !); Malwan (Woodrow).—*Kanara :* Karwar (Talbot 3171 !, 2539, Hallberg and McCann A75 !, Lisboa); Katgal (Hallberg and McCann 9934 !); Castle Rock (Bhide !).

Distribution : W. Peninsula. Hooker f., but not Cooke, mentions also the Deccan Peninsula collected in by G. Thomson.

3. **Peltophorus Talboti**, comb. nov. Blatter and McCann.—*Rottbœllia Talboti*, Hook. f. in F. B. I. vii, 155 ; Cke. ii, 954.
Description : Cke. l. c.
Locality : Konkan : Vasco da Gama (Bhide !) ; Marmagoa (Talbot 2572 !).
Distribution : So far only been found in Goa.

16. LASIURUS, Boiss. (Stapf in Fl. Trop. Afr. ix, 60)

Perennial, more or less branched and woody below ; branches often in dense fascicles, intravaginal. Leaves linear, convolute or flat, hard ; ligule a fringe of hairs. Racemes silky-villous. Spikelets usually 3-nate, rarely 2-nate, on the more or less fragile rhachis of villous spike-like racemes which end the stems and branches (if any) and are supported by or exserted from often spathaceous sheaths, if 3-nate 2 sessile, the sessile different in sex from, but similar in shape to, the pedicelled ; rhachis nodes bearded all round ; joints and pedicels linear, the latter more slender and shorter, opposite the joints if 2 sessile spikelets be present, otherwise approximate, but not contiguous and parallel to one of the sides of the joint ; disarticulation at a right angle to the rhachis, scar at the tips of the joints suborbicular, smooth, often ciliate. Sessile spikelets, if 2, one on each side of the pedicel with a narrow ring-shaped callus. Florets 2, lower male, upper bisexual, awnless. Glumes unequal ; lower longer, subcoriaceous, flat on the back, acuminate, 2-keeled upwards and 2-dentate, densely ciliate, upper boat-shaped, membranous, keeled. Valves hyaline, 3-nerved. Valvules hyaline, 2-nerved. Lodicules 2, cuneate. Stamens 3. Stigmas linear, laterally exserted. Grain oblong, slightly dorsally compressed, embryo half its length. Pedicelled spikelet similar to the sessile, but with an indistinct glabrous callus and with both florets male or more or less reduced.

1. **Lasiurus hirsutus**, Boiss. Diagn. ser. II, iv, 146 ; Stapf Fl. Trop. Afr. ix, 60.—*Saccharum hirsutum*, Forsk. Fl. Aegypt.—Arab. 16.—*Rottbœllia hirsuta*, Vahl Symb. i, 11 ; Hack. Monogr. Androp. 311.—*Ischæmum mastrucatum*, Trin. in Mém. Acad. Petersb. 6me. sér. ii, 298.—*Ischæmum hirsutum*, Nees in Schimp. Pl. Arab. Fel. No. 791.—*Cœlorrhachis hirsuta*, Brongn. *apud* Dcne. in Ann. Sci. Nat. ser. 2, ii, 13.—*Elionurus hirsutus*, Munro *apud* Benth. in Journ. Linn. Soc. xixv, 68 ; Boiss. Fl. Or. v, 466 ; Hook. f. in F.B.I. vii, 162 ; Cke. ii, 973.
Description : Cke. l.c.
Locality : Sind : Karachi (Bhide !) ; Sehwan to Laki, foot of hills (Sabnis B613 !) ; Umarkot, sandy plains (Sabnis B940 !).
Distribution : Nubia, Egypt, Brit. Somaliland, Arabia, Afghanistan, Baluchistan, Punjab, Sind, Rajputana.

17. ELYONURUS, Humb. and Bonpl. (Stapf in Fl. Trop. Afr. ix, 62)

Usually perennial, cæspitose, aromatic grasses. Blades of leaves flat or folded ; ligules very short, membranous. Racemes erect, joints strongly compressed, usually villous, tips oblique, not appendaged. Spikelets similar, usually awnless, differing in sex, 2-nate, one sessile, the other pedicelled, on the articulate fragile rhachis of solitary spike-like racemes, the sessile deciduous with the adjacent joint of the rhachis and the pedicel. Florets 2 : Lower reduced to an empty valve, upper bisexual in the sessile male, rarely barren, in the pedicelled spikelet. Glumes equal : Lower subcoriaceous to herbaceous, often 9-toothed or 2-fid, rarely awned, dorsally flattened, 2-keeled, usually with fine filiformed transparent balsam ducts close to the ciliate or penicillate keels ; upper membranous, lanceolate, acute, rarely awned. Valves hyaline, awnless. Valvule obsolete or absent. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong, dorsally compressed ; embryo about half the length of the grain.
Species about 15.—Tropical and subtropical regions of both hemispheres.

1. **Elyonurus Royleanus**, Nees ex. A. Rich. Tent. Fl. Abyss. ii, 471 ; Hack Monogr. Androp. 343 ; Hook. f. in F.B.I. vii, 161 ; Duthie Grass. N.W. Ind. 17, and Fodd. Grass. N. India 28, t. 54 ; Cke. ii, 972 ; Stapf in Fl. Trop. Afr. ix, 65.—*E. Griesebachii*, Schmidt, Beitr. z. Fl. Capverd. 154.—*Ratzeburgia Schimperi*, Steud. Nomencl. ed. ii, 439.—*Rottbœllia elegantissima*,

Hochst. ex. Steud. Syn. Pl. Glum. i, 365.—*Andropogon elegantissimus*, Steud. Syn. Pl. Glum. i, 365—*Andropogon Griesebachii*, Steud. Syn. Pl. Glum. i, 365.

Description : Cke. l.c.

Locality : Sind : (Woodrow).—*Gujarat :* Bhodir Maka, Cutch (Blatter 3747 !) ; Bhuj, Cutch (Blatter 3795 !) ; Rajkot, Kathiawar (Woodrow).

Distribution : Upper Gangetic Plain, Rajputana, W. Peninsula, Arabia, Somaliland, Eritrea, Abyssinia, Sudan, Nubia, Cape de Verd Islands.

18. ROTTBOELLIA, Linn. f. (Stapf. in Fl. Trop. Afr. ix, 72)

Annual, usually coarse grasses, often with stilt-roots from the lowest nodes, more or less branched, particularly upwards. Leaves large, linear-lanceolate, rather wide ; ligule membranous, short. Racemes dorsiventral, with the spikelets placed anticously and laterally. Spikelets 2-nate on the nodes of the very fragile rhachis of stout cylindric perfectly glabrous spike-like racemes which end the stems and their branches, in the latter case spathe-supported, different in sex and usually in size, colour and nervation except those of the uppermost pairs which are barren, homomorphous and upwards increasingly reduced forming a tail-like appendage to the raceme. Joints dorsally flattened below, widely cup-shaped and hollowed out upwards, more or less completely fused with the pedicels along their posticuous angles. Sessile spikelets pale, triangular in transverse section ; the narrow callus fused with the bases of the adjacent joint and pedicel into a glabrous ring from the centre of which protrudes a knob fitting into the cup-shaped hollow of the next lower joint, the whole plexus falling together. Florets 2, lower male, upper bisexual, awnless Glumes equal : Lower coriaceous, flat on the back, with very narrow inflexed margins, 2-keeled upwards ; upper boat-shaped, keeled upwards, acute. Valves hyaline, 3-nerved. Valvules as long or almost as long as the valves, hyaline, 2-nerved. Lodicules, 2, cuneate. Stamens 3. Stigmas suberect or shortly laterally exserted above the middle of the spikelet. Grain broad-oblong or ellipsoid, dorsally compressed ; hilum large, suprabasal ; embryo almost as long as the grain. Pedicelled spikelet similar to the sessile, but more compressed, green, striate, with two male florets, or smaller and more or less reduced.

Species 2 or 3.—Tropics of the Old World.

1. **Rottboellia exaltata,** Linn. f. Suppl. 114 ; Roxb. Pl. Corom. t. 157 ; Fl. Ind. i, 354 ; Duthie Grass. N.W. Ind. 17 ; Hack. Monogr. Androp. 293 ; Hook. f. in F.B I. vii, 156 ; Cke. ii, 955.—*R. exaltata*, var. *genuina*, Schweinf. in Höhnel Disc. Lakes Rudolf and Stefanie, ii, App. 352.—*R. exaltata*, f. *arundinacea*, Hack. in Bot. Soc. Brot. v, 215.—*R. arundinacea*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 444.—*Stegosia cochinchinensis*, Lour. Fl. Cochinch. 51.—*Stegosia exaltata*, Nash in Amer. Fl. xvii, i, 84.

Description : Cke. l.c.

Locality : Konkan : Dohe forest, Thana Dist. (Ryan 711 !).—*Deccan :* Agricultural College Farm (Herb. Econ. Bot. Poona !) ; Poona (Bhide !, Cooke, Woodrow 2 !) ; Purandhar 4,000 ft. (McCann 5591 !).—*S. M. Country :* Dharwar, in field (Sedgwick 5469 !) —*Kanara :* Hattikeri, near Karwar (Hallberg and McCann A74 !).

Distribution : India, Andamans, Ceylon, China, Malaya, Australia, Africa.

var. **robusta,** Hook. f. in F.B.I. vii, 156.

Description : Leaf-base more cordately confluent with the sheath. Spikes stouter below, slender above the middle. Spikelets in upper half distichously imbricate, longer than the joints, fertile nearly to the tip. Pales of upper floral glume auricled at the base.

Locality : Poona (Woodrow).—We have not seen this plant.

Distribution : Malabar, Palamcotta.

19. OPHIURUS, Gærtn. *partim ;* R. Br. (Stapf Fl. Trop. Afr. ix, 74)

Annual (?) or perennial, sometimes very coarse grasses, usually much branched upwards. Leaves linear to lanceolate, short to very long, conduplicate or convolute in bud, then flat ; ligules very short, membranous. Racemes dorsiventral. Spikelets solitary on the nodes of the fragile rhachis of slender cylindric spikes which end the stems and their usually fascicled spathe-supported branches, their pedicelled companions suppressed or rudimentary and very minute and the pedicels completely fused with the joints, both forming together a deeply

hollowed-out cylindric receptacle ; disarticulation of the internodes at a right angle or slightly oblique to the rhachis, their tips hollowed out. Sessile spikelet with a very narrow callus which is fused with the base of the internode into a rim from the centre of which protrudes a small knob fitting into the hollow of the next lower internode, the whole plexus falling together. Florets 2, lower male or neuter, upper bisexual, awnless. Glumes equal : Lower coriaceous, flat or subconvex on the back with very narrow inflexed margins, faintly nerved with a transverse groove at the base, upper boat-shaped, hyaline, obtuse. Valves hyaline, 2-nerved or nerveless. Valvules similar to the valves. Lodicules 2, cuneate. Stamens 3, Stigmas short, laterally exserted. Grain oblong, dorsally slightly compressed ; embryo 1/4 the length of the grain.

Species about 4.—From the Sudan through tropical Asia to Australia.

Stapf has described the species *Ophiurus megaphyllus* which forms part of *O. corymbosus*, Hook. f. in F.B.I. vii, 160 (not of Gærtn. f. and not of *Rottbœllia corymbosa*, Linn. f.). What is left over of Hook. f's *O. corymbosa* after the separation of *O. megaphyllus* has to go under *O. corymbosa*, Gærtn.

I. Leaves ensiform, very hairy. Robust, 1·5–1·8 m. 1. *O. megaphyllus*.
II. Leaves linear, glabrous. Slender, 0·6–1·2 m. ... 2. *O. corymbosus*.

1. **O. megaphyllus,** Stapf in Haines Bot. Bihar and Orissa pt. V (1924), 1058.—*Ophiurus corymbosus*, Hook. f. in F.B.I. vii, 160, *partim* (non Gærtn. f.); Cke. ii, 951, *partim ;* Hack. Monogr. Androp. 317 (*partim*).

Description : A large stout grass, 1·5–1·8 m. high, very leafy to the top. Leaves narrowly ensiform, tapering from base to apex, upper 10–18 mm. wide, lower much wider, flat, very hairy as are the sheaths, but more or less glabrescent with age, hairs with small tubercle bases, margins of sheath hirsute. Spikelets 2–4 mm., slightly shorter or longer than the joints, in very numerous peduncled spikes 7·5–10 cm. long, from the leaf-axils. Peduncles 7·5–12·5 cm., sheathed at the base, finally far exserted, each solitary on a branch with a villous node, often geniculate at the node. Sessile spikelets : Glumes 4 : Lower involucral glume oblong, glabrous, with rounded tip, smooth or with few lines of small pits, not becoming recurved, sometimes bearing a small appendage. Upper involucral glume white, becoming inclined forward, quite free from the rhachis when the spikelet opens. Pedicelled spikelets : the lowest are sometimes free at the top and bear a small brown free appendage.

Locality : We have not been able to examine all the specimens which were formerly put under *O. corymbosus*, Hook. f. and we are, therefore, not in a position, to assign any specimen to *O. megaphyllus*, Stapf.

Distribution : To make a definite statement all the herbarium material of *O. corymbosa*, Hook. f. would have to be examined.

2. **O. corymbosus**, Gærtn. f. Fruct. iii, 4, t. 181 f. 3 a (*Ophiuros*) ; Haines Fl. Bihar and Orissa, pt. V (1924), 1058 ; *Rottbœllia corymbosa*, Linn. f. Suppl. 114.—*O. corymbosa*, Hook. f in. F. B. I. vii, 160, *partim ;* Cke. ii, 951, *partim.*

Description : Perennial. Stems very numerous, glabrous, erect, slender, 0·6–1·2 m. high, bulbous at the base, the bulbous bases connected into a horizontal rhizome. Leaves linear, glabrous, up to 5 mm. broad, margins minutely tubercled at base, the tubercles bearing cilia when young. Spikes very slender, 5–12·5 cm. long, sometimes ending in a small tail like that of a rattle-snake (Haines), spikelets 2·5 mm. long, equalling the joint. Lower involucral glume of sessile spikelet glabrous, with many longitudinal lines of small pits, narrowly oblong, tip rounded, finally recurved.

Locality : Deccan : Deolali (Blatter and Hallberg 4564 !) ; Nasik Road (Blatter 9624 !) ; Talegaum (McCann !).

20. Cœlorrhachis, Brown. (Stapf in Fl. Trop. Afr. ix, 78)

Mostly tall, coarse, perennial grasses, much-branched upwards. Racemes with the sessile spikelets which are often imbricate, placed anticously and pedicelled laterally. Spikelets 2-nate on the nodes of the fragile rhachis of slender, more or less compressed conspicuously dorsiventral spike-like racemes which end the stems and their usually fascicled, spathe supported branches, different or very rarely alike in sex, similar in shape or the pedicelled more or less or very much reduced ; joints and pedicels similar or the latter more slender,

linear to cuneate or subclavate, dorsally compressed, glabrous, contiguous or nearly so; disarticulation of the joints at a right angle to the rhachis, their tips more or less hollowed out, with or without an ear-shaped appendage. Sessile spikelet dorsally compressed, the narrow transverse callus fused with the base of the adjacent joint and pedicel into an obscure rim from the centre of which protrudes a knob fitting into the hollow of the next lower joint, the whole plexus falling together. Florets 2, the lower usually reduced to the valve with a small valvule, always neuter upper bisexual, awnless. Glumes subequal; lower flat or slightly convex on the back, smooth or variously sculptured, with narrow inflexed margins, 2-keeled upwards and more or less winged from the keels, obtuse or emarginate, very faintly nerved; upper chartaceous, keeled, acute, 1–3 nerved. Valves hyaline, of lower floret 2-nerved or nerveless, of upper 3–1-nerved or nerveless. Valvule hyaline, similar to the valve, 2-nerved or nerveless. Lodicules 2, cuneate. Stamens 3. Stigmas shortly laterally exserted. Grain oblong, dorsally compressed; embryo about half the length of the grain. Pedicelled spikelet very varied, similar to the sessile or more or less reduced or rudimentary, male or neuter, very rarely bisexual.

Species about 12. Tropics of both hemispheres.

1. **Cœlorrhachis Clarkei** comb. nov. Blatter and McCann. *Rottbœllia Clarkei*, Hack. in Oestr. Bot. Zeitschr. 41 (1891), 8; Cke. ii, 954. *Rottbœllia gibbosa*, Hack. ex Lisboa in Journ. Bomb. Nat. Hist. Soc. vi. (1891), 195.

Locality: Kanara: Birchy (Talbot 2820 !, 2072); Jugglepet (Talbot 1566 !)

Distribution: Chota Nagpur, W. Peninsula.

(*To be continued*)

THE MOGHUL EMPERORS OF INDIA AS NATURALISTS AND SPORTSMEN

BY

SALIM A. ALI

PART II

(With four plates)

(Continued from page 861 of Vol. XXXI)

THE WILD ASS (*Equus onager indicus*)

According to Abul Fazl [1] the Wild Ass was hunted in the Sarkar of Tattah (Sind). He gives an account of a hunt by the Emperor Akbar (*circa* April, A.D. 1571) which took place at Harhāri near the River Sutlej (in the Punjab) as follows : " The scouts having reported that there was a herd of wild asses (*Gorkhar*), the sovereign proceeded to hunt them attended by three or four special huntsmen. When he came near the plain, he dismounted and proceeded on foot. At the first shot he hit an ass and the rest of the herd fled far away at the report of the gun. That Divine World Hero took his piece in his hand and proceeded rapidly on foot over the burning sand attended by the same three or four huntsmen. He soon traversed the plain and came up with the herd and killed one after the other with his gun ; he continued to follow them up and on that day he shot thirteen wild asses. Whenever he killed one the others went farther off than at first (before)." The chronicler tells us that Akbar followed this herd till thirst brought about such exhaustion that he lost the power of speech.

One of the items appearing on the list of game shot by Jehangir in the course of a *qamargah* hunt at Girjhāk (in the neighbourhood of Kalpi ?) is " ten Wild Asses ". [2] By the Emperor's orders the largest and strongest of these was weighed and found to be 9 maunds 16 seers equal to 76 Persian (*Vilayeti*) maunds (equivalent to 324½ lbs.). Regarding the qualities of its flesh as a table delicacy Jehangir observes : ' Though the flesh of the wild ass is lawful food (*halal*) and most men like to eat it, it was in no way suited to my taste.'

THE YAK (*Bos grunniens*)

Abul Fazl mentions[3] that this animal was found in the northern mountainous parts of the Subah of Kumaon. Further on he describes the animal as follows : " The Yak approximates to the domestic cow, but of its tail is made the '*kutas*' or fringed tassel and many they join together."

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[1] *Ain*, vol. ii, p. 338. [2] *Jeh.*, vol. i, p. 83. [3] *Ain*, vol. ii, p. 280.

Jehangir records [1] that one day two Yaks out of the offerings of the Zamindar of Tibet were brought before him and regarding these he observes: "All the limbs are covered with wool which properly belongs to animals in a cold country. For instance the *Rang* goat (Ibex) which they brought from the country of Bakkar (Sind) and the hill country of the Garmsir (Afghanistan) were very handsome but had little wool, and those that were met with in these hills (Tibet), on account of the excessive cold and snow are covered with hair and ugly. In form and appearance they (the Yaks) closely resemble the buffalo."

Jehangir is here doubtless, differentiating between the close-haired Ibex of the Sind Hills and its congener the Himalayan Ibex of the high altitudes of the Central Asian region.

According to Blanford the Yak in the wild state is only found within Indian limits in Northern Ladak in the neighbourhood of Chang Chenmo. Hodgson described it as occurring in the northern region of Nepal in the immediate vicinity of the snows. It is possible that the Subah or province of Kumaon in Akbar's day extended into Tibet which was a dependancy of the Moghul Empire.

The Wild Buffalo (*Bos bubalus*)

Babur describes [2] the animal thus: "It is much larger than the common buffalo. Its horns go back like those of the common buffalo, but not so as to grow into the flesh. It is a very ferocious and destructive animal."

Babur's view is upheld by Blanford and by most sportsmen of the present day that the wild buffalo is by far the most savage and the boldest of Indian Bovidæ.

The habitat of this beast at present is mainly Nepal, Assam, Bengal, Orissa and certain portions of Central India where it is locally distributed. In Akbar's time, according to his historian[3] wild buffaloes were numerous in Oudh. "When the plains are inundated," he informs us, "the animals take to high ground where people find sport in hunting them. Some of the animals remain all day in the water and only at night approach the dry ground and breathe in freedom."

According to the same author [4] various methods were employed in hunting the wild buffalo, the commonest being to decoy a bull by means of a tame cow on heat and to entangle him with nooses slipped round his legs by hunters lying in ambush.

Mountain Sheep (*Oorial or Burhel* ?)

Jehangir records [5] that in the course of two *Qamargah* hunts, one at Girjhāk and the other at Nadīnā (somewhere in the neighbourhood of Kalpi ?) one hundred and eighty mountain sheep were killed. The Emperor ordered a large ram to be weighed and it came to 2 maunds 3 seers (Akbari) equal to 70 Persian (Vilayeti) maunds which would be equivalent to 71½ lbs. It will be noted that the Moghul Emperors invariably appraised their game by weight,

[1] *Ibid.*, vol. ii, p. 151. [2] *Babur*, vol. ii, p. 211. [3] *Ain*, vol. ii, p. 125.
[4] *Ain*, vol. i, p. 293. [5] *Jeh.*, vol. i, p. 83.

only in a very few instances is any attention paid to the length of horn and other dimensions so dear to the heart of the modern sportsman.

Continuing on the subject, Jehangir observes: "I have frequently heard from hunters and those fond of the chase that at a certain regular time a worm develops in the horn of the mountain ram, and this causes an irritation which induces the ram to fight with its hind, and that if he finds no rival he strikes his head against a tree or rock to allay the irritation. After inquiry it seems that the same worm appears in the horn of the female sheep, and since the female does not fight, the statement is clearly untrue."

The reference no doubt is to the larva of the parasitic fly *Œstrus ovis* L. which occurs in sheep causing the well-known giddiness.

The 'Rang' or Ibex (*Capra* sp.)

Jehangir[1] thus describes an ibex shot and brought to him: "It is like a mountain goat and there is a difference only in its horns. The horns of the 'Rang' are bent (backwards) and those of the goat (obviously meaning Markhor) are straight and convoluted."

In regard to 24 ibex which were captured alive in the course of a *Qamargah* hunt near Kabul, the Emperor observes[2]: "I had never till now seen a *Rang* antelope alive. It is in truth a wonderful animal of beautiful shape. Although the Black-buck of Hindustan looks very finely made, the shape and fashion and appearance of this antelope is quite a different thing. They weighed a *Rang* and it came to 2 maunds 10 seers (Akbari) (equal to 77½ lbs.). The *Rang* although of this size (i.e., heavy) ran so that 10 or 12 swift dogs were worn out and siezed it with a hundred thousand difficulties."

Jehangir describes his experiment of crossing the ibex with a Barbary goat in the following terms. The translation speaks of the former animal as "Markhor" but from the sketches of the goats, both parents and hybrids, made at the time (A.D. 1619) under the Emperor's orders it is apparent that the ibex and not the markhor was the species experimented with. Says Jehangir,[3] "At Ahmedabad I had two markhor (?) goats. As I had not a female in my establishment to pair with them, it occurred to me that if I could pair them with Barbary goats which they bring from Arabia, especially from the port of the city of Darkhar[4] young of their form and qualities might be obtained. In short I paired them with seven Barbary ewes (she-goats) and after six months had elapsed each of the latter had a young one at Fatehpur. There were four females and three males very pleasing in appearance, of good shape and good colour. In their colour, those kids which resembled the male were dun coloured with black stripes on their backs. . . . Of their liveliness and laughable ways and their manner of gamboling and leaping what can be written? Some of their ways are such that the mind derived uncontrolled pleasure from looking at them. . . . When one month or even 20 days old, they would leap

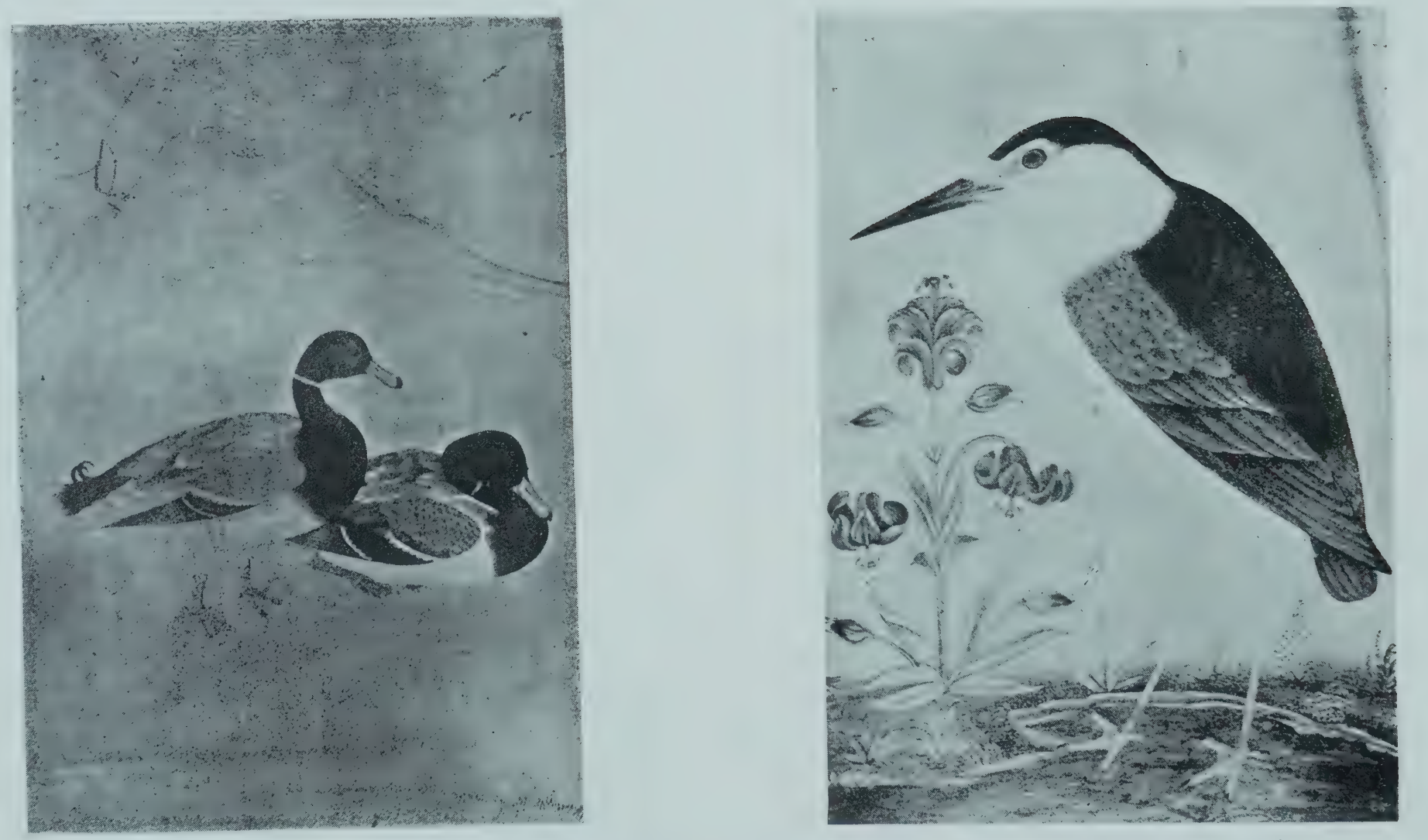
[1] *Jeh.*, vol. i, p. 109. [2] *Ibid.*, p. 121. [3] *Ibid.*, vol. ii, p. 88.
[4] The ancient Dhafar on the south coast of Arabia, known as Mirbat.



SKETCHES OF IBEX-GOAT HYBRIDS (SEE 'IBEX')
(Painted A.D. 1619; collection of M. Demotte, Paris.
By courtesy of the Publishers 'Indian Painting under the Moghuls.'—Percy Brown.



NILGAI.
(*From a Moghul painting in the Prince of Wales Museum, Bombay.*)



MALLARD AND NIGHT HERON (Painted A.D. 1630; Album of Prince Dara Shikoh; India Office Library)
By courtesy of the Publishers, 'Indian Painting under the Moghuls.'—Percy Brown.

upon high places and throw themselves on the ground in a way that if any other but a kid were to do so, not one limb would be left entire. As it pleased me I ordered them always to be kept near me, and I gave each of them an appropriate name. I am much delighted with them and pay much attention to bringing together markhor (ibex) males and well-bred she-goats. I desire to have many young ones from them that they may become well known among men. After their young shall have paired, most probably more delicate ones will be obtained. One of their peculiarities is that ordinary kids, immediately they are born and until they begin to suck, make a great bleating, whilst these on the contrary make no sound and stand quite contented and without wailing. Perhaps their flesh would be very pleasant to the taste."

The agility of the ibex appears to have particularly excited the Emperor's amazement. He mentions[1] in regard to a tame ibex fawn eight days old that " it jumped down from the terrace of the palace which is 8 gaz (20 ft.) in height on to the ground and began to leap about, no sign of injury or pain being perceptible in it."

It is interesting to compare Jehangir's ibex-goat hybrids in the plate here reproduced with the photo illustrating a similar cross which appeared with a note by Col. A. E. Ward on page 519 of vol. xxxi of the Society's Journal.

The Markhor (*Capra falconeri*)

I have no doubt that the animal referred to as " Mountain Goat " in Jehangir's memoirs is no other than this. The Emperor mentions that as compared with the *Rang* (ibex) whose horns are bent backwards, the horns of this animal were straight and convoluted. This clue alone would suffice to establish its identity. Jehangir[2] continues on the subject. " I found the flesh of the Mountain Goat more delicious than of all wild animals; although its skin is exceedingly ill-odoured, so much so that even when tanned the scent is not destroyed. I ordered one of the largest of the Hill Goats to be weighed; it was 2 maunds and 25 seers equal to 21 foreign (Persian or Vilayeti) maunds."

The weight would be equivalent to 90½ lbs.

The Nilgai or Blue Bull (*Boselaphus tragocamelus*)

The first Moghul emperor to refer to this animal was Babur, who described it in his Memoirs[3] thus: " Its height is equal to that of a horse. It is somewhat slender. The male is bluish whence it is called the *Nil-gau* (Blue Ox). It has two small horns and on his neck has some hairs, more than a span in length, which bears much resemblance to the mountain-cow's (yak) tassels.[4] Its tail is like the bull's. The colour of the female is like that of the 'Gawazen' deer (Red Deer)."

All the Moghul emperors appear to have been extremely fond of hunting the Nilgai. Jehangir in particular was devoted to it, and

[1] *Jeh.*, vol. ii, p. 204.
[2] *Ibid.*, vol. i, p. 83.
[3] Vol. ii, p. 211.
[4] Known as *kutas* or *qutas*.

makes repeated references to the sport in his memoirs. I give an account of one such hunt in the Emperor's own words which will suffice our purpose. He writes : " On this day (in A.D. 1610) was killed a Nilgau of the weight of 9 maunds and 35 seers (equivalent to 340¾ lbs.). The story of this nilgau is written because it is not devoid of strangeness. In the past two years during which I had come to this same place to wander about and hunt, I had shot at him each time with a gun. As the wounds were not in a fatal place, he had not fallen but gone off. This time I again saw that nilgau in the hunting ground and the watchman recognized that in the two previous years he had gone away wounded. In short I fired at him again three times that day. It was in vain. I pursued him rapidly on foot for 3 kos but however much I exerted myself I could not catch him up. At last I made a vow that if this nilgau fell I would have his flesh cooked, and for the sake of Khwājā Muīn-ud-dīn (who was Jehangir's patron saint) would give it to eat to poor people. I also vowed a muhr (gold mohur) and a rupee to my revered father. Soon after this the nilgau became worn out with moving and I ran to his head and ordered them to make it lawful (cut its throat in the name of Allah) on the spot, and having brought it to the camp I fulfilled my vow as I had proposed. They cooked the nilgau, and expending the muhr and rupee on sweets, I assembled poor and hungry people and divided these among them in my own presence.

Two or three days afterwards I saw another nilgau. However much I exerted myself and wished he would stand still in one place so that I might fire at him, I could get no chance. With my gun on my shoulder I followed him till near evening until it was sunset and I despaired of killing him. Suddenly it came across my tongue " Khwājā, this nilgau is also vowed to you." My speaking and his sitting down were at one and the same moment. I fired at him and hit him and ordered him like the first nilgau to be cooked and given to the poor to eat."[1]

From the above account it will be seen that unlike so many potentates of the present day, the Moghul emperors spared no personal exertion in pursuit of sport.

The killing of female game was apparently not looked upon as unsporstmanlike in Jehangir's time. He tells us that he once shot a female nilgau from the stomach of which two fully formed fœtuses were obtained. " As I had heard," writes the Emperor, " that the flesh of nilgai fawns was delicate and delicious, I ordered the royal cooks to prepare a *dupiyaza* (a kind of rich fricassee,[2]) and he remarks that " certainly it was not without flavour."

The Four-horned Antelope (*Tetracerus quadricornis*)

Jehangir[3] writes : " On the road to the village of Qāsim-khēra in the Subah (province) of Mālwa a white (probably meaning pale brown) animal was killed which resembled the *Kotah-payeh* (Hog Deer) ; it had four horns, two of which were opposite the extremities of its eyes and two finger-breadths in height, and the other two

[1] *Jeh.*, vol. i, p. 189. [2] *Ibid.* [3] *Jeh.*, vol. i, p. 352.

horns 4 finger breadths towards the nape of the neck. These were 4 finger breadths in height. The people of India call this animal *Dūdhādhārit*. The male has four horns and the female none. It was said that this kind of animal had no gall-bladder, but when they looked at its intestines the gall-bladder was apparent, and it became clear that this report has no foundation."

One of the Hindustani names for the four-horned antelope is *Doda*, which may be an abbreviated form of that mentioned by Jehangir.

The Indian Antelope or Black Buck (*Antilope cervicapra*)

In dealing with the fauna of Hindustan, Babur[1] refers to this animal in the following terms: "There is a species of deer that resembles the male *huneh* or *jiran*.[2] Its back is black, its belly white, its horns longer than those of the *huneh* and more crooked. The Hindustanis call it *kalhāreh*. The word was probably *kālā hiran* (black deer), which they have corrupted into *kalhāreh*. The female is white (meaning doubtless, pale brown). They take the deer by means of this *kalhāreh*. They make fast a running net to its horns and tie a stone larger than a football to its leg, that after it is separated from the deer it may be hindered from running far. When the deer sees the wild *kalhāreh* it advances up to it presenting its head. This species of deer is very fond of fighting and comes on to butt with its horns. When they have engaged and pushed at each other with their horns, in the course of their moving backwards and forwards, the net which has been fastened to the tame one's horns gets entangled in those of the wild deer and prevents its escape. Though the wild deer uses every effort to flee, the tame one does not run off and is greatly impeded by the stone tied to its leg which keeps back the other also. In this way they take a number of deer which they afterwards tame. They likewise take deer by setting nets. They breed this tame deer to fight in their houses. It makes excellent battle."

Writing in the reign of the Emperor Akbar, the historian Abul Fazl, after enumerating a number of methods then in vogue for hunting and capturing black buck, the most popular of which has been so graphically described by Babur and is still employed, informs us that regular deer studs were maintained where black buck were bred and trained as decoys for catching and hunting wild antelope.

While on the subject of black buck, Jehangir recounts an incident which he says "has been written because it is not void of strangeness. At Chāndwālah I had wounded in the belly a black antelope. When wounded a sound proceeded from him such as I have never heard from any antelope except in the rutting season. Old hunters and those with me were astonished and said they never remembered, nor had they heard from their fathers that such a voice issued from an antelope except at the rutting season."

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[1] *Babur*, vol. ii.

[2] It has been suggested that this may be either *Gazella subgutturosa* or *Saiga tartarica*.

He further relates[1] that while hunting in the pargana of Karnal (Punjab) with about 30 of his huntsmen (*circa* 1618 A.D.) they came in sight of a black buck with some does. "We let loose a decoy antelope to fight him. They butted two or three times and then the decoy came back. A second time I wanted to put a noose on its horns and let it go that it might capture the wild one. Meanwhile the wild antelope in the excess of his rage, not looking at the crowd of men (i.e., unmindful), ran without regard to anything, and butting the tame buck two or three times, fought with it till it fled. The wild antelope thereupon made its escape."

The traveller Mons. de Thevenot, who visited India during the regime of Aurangzebe, writes of the black buck and the methods of capturing it as follows:—"The Indian Antelope are not altogether like those of other countries; they have even a great deal more courage, and are to be distinguished by their horns. The horns of the ordinary antelope are greyish, and but half as long as the Horns of those in the Indies which are blackish and a large Foot and a half long. The Horns grow winding to a point like a screw; and the Faquirs and Santons carry commonly two of them pieced together; they are armed with iron at both ends, and they make use of them as of a little staff.

When they use not a tame Leopard for catching of Antelopes, they take with them a male of the kind that is tame, and fasten a Rope about his Horns, with several nooses and doubles, the two ends whereof are tied under his belly; so soon as they discover a Heard of Antelopes, they slip this male and he runs to join them. The Male of the Heard advances to hinder him, and making no other opposition but playing with his horns, he fails not to be pestered and entangled with his rival, so that it being uneasy for him to retreat, the Huntsman cunningly catches hold of him and carries him off; but it is easier to catch the male than the females."

Here again we find that the favourite method of capturing black buck was the same as employed in Babur's time, over a century previously. The dodge as practised to-day shows very little modification.

The Chinkara (*Gazella bennetti*) or Muntjac (*Cervulus muntjac*)?

Sir Lucas King, the annotator of Erskine's translation of Babur's Memoirs, in a footnote conjectures that the animal described by the Emperor in the following words may be a Chinkara. If this view is correct, it appears curious that Babur should not have remarked upon the similarity of this animal to the Persian Gazelle (*Gazella subgutturosa*) which was evidently familiar to him (cf. Black Buck) and closely allied to this species. Babur states:—"There is on the skirts of the mountains another deer which is smaller; it may be equal in size to a sheep of a year old."

In view of the somewhat vague account, I think it may be permissible to hazard a guess that possibly the Muntjac is what is meant.

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[1] *Jeh.*, vol. ii, p. 42.

Red Deer (?)

The identity of this animal is uncertain. According to Jehangir[1] they were plentiful in the hills of Rohtas (Punjab) ? and were found nowhere else in Hindustan except at Girjhāk and Nandāneh (near Kabul ?) The Emperor writes :—" I ordered them to catch and keep some of them alive in order that possibly some of them might reach Hindustan for breeding purposes."

Unfortunately no further records are available regarding this proposed introduction of the deer.

Is it possible that the Emperor is here referring to the Eastern Red Deer, misnamed the Maral, (*Cervus elaphus maral*) whose range extends from the Caucasus to Northern Persia and may have in Babur's day included Afghanistan and the neighbouring provinces of the Punjab ?

The only mention of Sambar (or Barasinga ?) made in Jehangir's notes is in his game register. In the list of game killed by him which appeared with the first part of this article, one of the items is *Maka* which for the reason stated in my footnote, may refer to either to Sambhar or Swamp Deer (*Barasinga*). As mentioned by Blanford, *Máhá* is the Hindi name for the Swamp Deer and *Mahá* the Terai for Sambar.

The Hog Deer (*Hyelaphus porcinus*)

Babur describes this deer which he calls *Kotah paicheh* (i.e. " Shortlegged ") as follows : " Its size may be equal to that of the white deer. Its forelegs as well as its thighs are short whence its name. Its horns are branching like those of the *gawazen* (Red Deer) but less. It is a bad runner and therefore never leaves the jungle."

Akbar's chronicler, Abul Fazl, mentions[2] that the sport of hunting this deer was much pursued in the Sarkar of Tattah—the present Sind. The animal is still plentiful in the tamarisk forests in the Indus and canal areas of that province and the zamindars display considerable fervour and ingenuity in hunting it.

The Musk Deer (*Moschus moschiferus*)

Abul Fazl[3] refers to this little animal in his Fauna of Hindustan thus : " The deer from which the musk is taken is larger than a fox, and his coat is rough. He shows two tusks or protruberances in place of horns. They are common in the northern mountains." In regard to its distribution the same author observes[4] that the Musk Deer was found in the Subah of Kumaon.

The Emperor Jehangir mentions[5] that while in Kashmir, the Zamindar of Tibet brought him a Musk Deer as offering. About this he writes : " As I had not tasted its flesh, I ordered it to be cooked ; it appeared very tasteless and bad for food. The flesh of no other animal is so inferior. The musk bag when fresh has no scent, but when it is left for some days and becomes dry it is sweet scented. The female has no musk bag."

[1] *Jeh.*, vol. i, p. 129. [2] *Ain*, vol. ii, p. 338. [3] *Ain*, vol. iii.
[4] *Ain*, vol, ii, p. 280. [5] *Jeh.*, vol, i, p. 151.

It is interesting to compare Jehangir's verdict on the flesh of this species as an article of food with Blanford's, who considers it as excellent and free from any musk flavour.

The Indian Wild Boar (*Sus cristatus*)

According to Abul Fazl [1] the Wild Boar was much hunted in the Sarkar of Tattah (Sind) where it is still plentiful and a serious pest to cultivation.

Jehangir mentions [2] that two pigs formed part of his bag in a *Qamargah* hunt which took place at Rawalpindi.

Sir Thomas Roe, the English Ambassador from James I to the court of Jehangir, writes in his journal [3] that on one occasion the king returning from a hunt "sent me a wild boar so large that he desired the tusks might be sent him back for their extraordinary size, sending word he had killed it with his own hand and bidding me eat it merrily."

Some time later, he again notes: "The king returning from hunting sent me a wild boar."

The Gangetic Dolphin (*Platanista gangetica*)

The animal referred to by Babur as *Khūk-e-ābi* is doubtless this species. From the fact that he describes it along with his crocodiles and fishes, it may be doubted if the Emperor realized its true position. Of course, by analogy of habitat alone it has at least as much right to be classed with the fishes as Babur's Flying Fox had to be with his birds.

The cetacean is thus described: "It is found in all the rivers of Hindustan. It springs up from the water with a jerk, puts up its head and plunges it down again, leaving no part of its body visible except the tail. The jaw of this animal too is like that of the crocodile. It is long and has the same kind of ranges of teeth; in other respects its head and body are like that of a fish. While playing in the water it resembles a water bag (mushak). The *khūk-e-ābi* (water hogs) that are in the River Saru (the Sirju or Gogra) while sporting leap right out of the water. This animal too resembles the fish in never leaving the water."

BIRDS

The Crow (*Corvus splendens* ssp. ?)

In dealing with the birds of his new dominions, Babur describes [4] what he calls the "*Alā-khūrgeh* of Hindustan" as follows: "It is slenderer and smaller than the *Alā-khūrgeh* of my native country and it has some white (? whitish) on the neck." Babur undoubtedly refers to the Hooded Crow (*Corvus capellanus*) in speaking of the crow of his country.

In a footnote, Sir Lucas King suggests that the bird referred to may be the Carrion Crow (*Corvus cornix sharpi*) but as this is by

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[1] *Ain*, vol. ii, p. 338.
[2] *Jeh.*, vol. i, p. 129.
[3] *Pinkerton's Travels*, vol viii.
[4] *Babur*, vol. ii, p. 221.

no means a common species (being a somewhat rare visitor to the extreme north-west of India only) and besides has no grey or white about the neck which is glossy black, I am inclined to believe it highly probable that Babur's bird is no other than our vulgar friend the House Crow—possibly *C. s. zugmeyeri* the Sind Crow, which has a particularly pale, almost whitish neck.

The Tree Pie (*Dendrocitta rufa* ssp. ?)

"Another is the *Aakeh* of Hindustan; they call it *mita*. It is a little smaller than the common *aakeh* (magpie) which is particoloured black and white, while the *mita* is particoloured brown and black." [1]

The Green Magpie (*Cissa chinensis chinensis*)

Babur's description of what may possibly be this bird is very vague. He compares it in appearance to the *Shiqraq* which according to King, is the Arabic name for the Green Magpie, and says, "It lives close among and about trees, and may be about the size of a *shikrak*. It is green-coloured like the parrot."

Abul Fazl's reference to it is somewhat more definite. Among the birds found in the Sarkar of Sylhet (Assam) he mentions one as the *Sherganj* and says, "It is of the same kind (as the Racket-tailed Drongo) but its beak and legs are red; in imitating sounds it matches the other, and pursues sparrows and the like and eats them." Among the vernacular names of this bird in the *F.B.I. Birds*, vol. i, 1st and 2nd editions, both Oates and Stuart Baker give *Sirganj* as the Bengali. The latter states that its food consists of insects, small unfledged birds, etc.

The Racket-tailed Drongo (*Dissemurus paradiseus* ssp. ?)

Abul Fazl[2] describes this bird from the Sarkar of Sylhet (Assam) thus: "The *Bhangrāj* is a bird of black colour with red eyes and a long tail. Two of the feathers extend to the length of a *gaz*. They are snared and tamed. It catches the note of any animal that it hears and eats its flesh."

The Scarlet Minivet (*Pericrocotus speciosus*)

Another bird which Babur compares in size to the *Sandulaj-mamula*, (which according to King is the Arabic for Wagtail) is probably this bird. The Emperor says "It is of a beautiful red, and on its wings has a little black."

The Dipper

Jehangir writes in Kashmir as follows: "I rode to see Sukh Nag.[3] It is a beautiful summer residence (*Ilaq*). The waterfall is in the midst of a valley and flows down from a lofty place.

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[1] *Babur*, vol. ii, p. 222. [2] *Ain*, vol. ii, p. 125.

[3] Perhaps this is the Shakar Nag of Jarrett (*Ain*, vol. ii, p. 361). The Sukh Nag River is mentioned by Laurence, 16. It may also be the waterfall mentioned by Bernier who says Jehangir visited the place and had a rock levelled in order to see properly.

There was still ice on its sides. . . . In this stream I saw a bird like a *Saj*. The *Saj* is of a black colour with white spots, while this bird is of the same colour as a bulbul (brown) with white spots, and it dives and remains for a long time underneath and then comes up from a different place. I ordered them to catch and bring two or three of these birds that I might ascertain whether they are waterfowl and were web-footed, or had open feet like land birds. They caught two and brought them. One died immediately and the other lived for a day. Its feet were not webbed like a duck's. I ordered Nadir-ul-asr Ustad Mansur (the celebrated animal painter) to draw its likeness. The Kashmiris call it *Galkar* that is ' Water *Saj* '."

This bird is either the Kashmir Dipper (*Cinclus c. cashmeriensis*) or the Indian Brown Dipper (*Cinclus pallasi tenuirostris*). The *Saj* to which it is compared may be the Spotted Forktail. Unfortunately I have no access to a reproduction of Al Mansur's painting referred to. This would doubtless have set the matter at rest.

Starlings, Mynahs, etc.

Babur mentions[1] the *Shārak* which he says " abounds in the Lamghanat and everywhere lower down over the whole of Hindustan. The *Shārak* is of different (various) species. One is that which is found in great numbers in the Lamghanat. Its head is black, its wings white, its size is rather larger than the *Chughur* and slenderer. It learns to speak."

In a footnote to this, King says: " The Persian has *Jāl* which is the Bokhara lark—*Melanocorypha torquata*--a common cage bird in India. *Chughur* is a large species of lark. The bird referred to here must be some sort of starling, possibly *Sturnus humii*." I can hardly imagine that King is correct in his conjecture. I have never heard of *Sturnus humii* sporting white wings ! Mrs. A. S. Beveridge, in her translation of the *Memoirs*, remarks " *Chughur-chug* in E. D. Ross's *Polyglot List of Birds* (p. 314) is the Northern Swallow. The description allows it to be *Sturnus humii*—the Himalayan Starling." (? ?)

Babur proceeds : " There is another sort which they call *Pindāweli*. They bring it from Bengal. It is all black. It is much larger than the other *Shārak*. In its two ears are yellow leathers which hang down and look very ugly. They call it the *Myna*. It learns to speak well and fluently."

This bird is obviously the Hill Mynah (*Eulabes intermedia*), a favourite cage bird, talker and mimic.

" There is another kind of *Shārak* a little slenderer than this last (the Persian adds, they call it *Wan Shārak*). It has red round the eye. This kind does not talk." King suggests in a footnote that this is possibly *Calornis chalybeius*—the Glossy Starling or Tree Stare. It is possible that his surmise may be correct though this species has no red round the eye, unless the irides are meant. To my mind the description suggests *Acridotheres ginginianus*, the Bank Myna.

[1] *Babur*, vol. ii, p. 216

The Baya (*Ploceus baya*)

Abul Fazl says, "The Baya is like a wild sparrow but yellow. It is extremely intelligent and docile; it will take small coins from the hand and bring them to its master, and will come to call from a long distance. Its nests are so ingeniously constructed as to defy the rivalry of clever artificers."

The Sparrow

Abul Fazl remarks upon the scarcity of these birds in the Province of Kashmir, and ascribes it to the general use in that country of pellet bows fitted with bow strings. Some doubt may be pertinently expressed as to the bird referred to in this note.

One of Akbar's diversions was to catch sparrows by the agency of frogs trained for the purpose.

The Wagtail

One of the things Jehangir records from the fortress of Mandu (in the present Dhar State) which he had never seen before in Hindustan was "the nest of a Wagtail (*Māmūla*) which they call in Persian *Dūm-sichā* ('Tail wagger'). Up till now, none of the hunters had pointed out its nest. By chance in the building I occupied there was its nest, and it brought out two young ones."

This wagtail would obviously be *Motacilla lugubris maderaspatensis*—the Large Pied Wagtail, which is the only resident species that breeds in India south of the Himalayas. This is the species, moreover, that is especially partial to holes in walls and buildings both empty and occupied for nesting sites.

The Pied Crested Cuckoo (*Clamator jacobinus*)

Jehangir says,[1] "In Hindustan there is a bird called *Papiha* of a sweet voice, which in the rainy season utters soul-piercing (*jān-sūz*) lament. As the Koyel lays its eggs in the nest of a crow and the latter brings up its young, so I have seen in Kashmir that the *papiha* lays its eggs in the nest of the *ghaughāi* (probably some species of babbler) and the *ghaughāi* brings up its young."

Abul Fazl writes about this cuckoo as follows: "It is a smaller bird than the koel with a shorter and slenderer tail. Its love is chanted in story. It is in full song in the beginning of the rainy season and has a peculiar note, and its plaintive strain is heard oftenest at night and makes love's unhealed wounds bleed anew. It is from its note that the word *piu* is taken, which in Hindi signifies 'Beloved.'"

The Koel (*Eudynamis scolopaceus scolopaceus*)

Babur says about it:—"Its length may be equal to the crow but is much thinner. It has a kind of song and is the nightingale of Hindustan. It is respected by the natives of Hindustan as much as the nightingale by us. It inhabits gardens where the trees are close planted."

[1] *Jeh.*, vol. ii, p. 164.

At a later date, Abul Fazl in his fauna of Hindustan refers to the bird as follows :—" The Koel is like a myna, jet black with crimson irides and a long tail. The romance sings of its loves as of those of the bulbul."

Jehangir's observations on the bird and its parasitic habits are remarkably thorough. He writes:—" The koel is a bird of the crow tribe but smaller. The crow's eyes are black and those of the koel red. The female has white spots but the male is all black. The male has a very pleasant voice quite unlike that of the female. It is in reality the nightingale of India. Just as the nightingale is agitated and noisy in Spring, so is the cry of the koel at the approach of the rainy season, which is the Spring of Hindustan. Its cry is exceedingly pleasant and penetrating, and the bird begins its exhilerations (*masti*) when the mangoes ripen. It frequently sits on the mango trees and is delighted with the colour and scent of the mango (a fruit of which the emperor himself was inordinately fond !) A strange thing about the koel is that it does not bring up its young from the egg, but finding the nest of the crow unguarded at the time of laying, it breaks the crow's eggs with its beak and throws them out, and lays its own in the place of them and flies off. The crow thinking the eggs its own, hatches the young and brings them up. I have myself seen this strange affair at Allahabad."

The Crow Pheasant (*Centropus sinensis*)

Babur describes the bird[1] as follows :—" This (bird) bears some resemblance to the Carrion Crow. In the Lamghanat they call it the Wood Fowl. Its head and breast are black, its wings and tail red; its eyes a very deep red. From its being weak and flying ill, it never comes out of the woods whence it gets its name of the Wood Fowl."

Paroquets

On the subject of the Paroquets of Hindustan, Babur writes[2] " There are many species of parrot; one is that which they carry into our countries (i.e. Turkestan) and teach to talk (*Palæornis nepalensis?*). There is another species of smaller size which is also taught to speak. They call it the ' Wood Parrot ' (*P. torquatus?*). Great numbers of this species are found in Bajour, Sawād and the neighbouring districts, insomuch that they go in flights of five or six thousand. These two species differ only in bulk—both have the same colours. There is another species of the parrot which is still smaller than the wood parrot. Its head is red as well as its upper feathers ; from the tip of its tail to within two fingers' breadth of its feet it is white. The head of many of this species is lustrous, and they do not speak. They call it the Kashmir Parrot."

I am afraid this last bird cannot be placed with any degree of certainty though it may of course be *P. cyanocephalus*, the Blossom-headed Paroquet. This species, however, has none of the white mentioned in the description, unless the pale yellowish-green

[1] *Babur*, vol. ii, p. 222. [2] *Ibid.*, pp. 214–15.

undertail coverts are so described. Moreover, the upper feathers are not red, unless the reference is to the wing-patches only.

Babur continues: "There is another species of parrot like the wood parrot but a little less. Its beak is red; round its neck is a broad black circle like a collar. Its upper feathers are crimson; it learns to speak well." This would appear to be *P. nepalensis*, the Large Indian Paroquet, a favourite cage bird in India, though in size it is larger, and not smaller, than *P. torquatus*.

"There is another kind of parrot of a beautiful red colour, it has also other colours, as I preciously do not recollet its appearance, I therefore do not describe it particularly. It is a very elegant bird and learns to talk; it has one great defect that its voice is particularly disagreeable as if you rubbed a piece of broken china on a copper plate."

The identity of this bird is obscure. It certainly does not appear to be *Coryllis vernalis* as suggested by King, as the colour of this species is green with scarlet patches on the rump and uppertail coverts only. Besides, I have never heard of a Lorikeet learning to talk, and its voice cannot be said to agree with Babur's graphic description. The only Indian bird that strikes me as being possibly referred to is *P. fasciatus* the Red-breasted Paroquet, which is found throughout the lower Himalayas, although its cry according to Blanford is much less harsh than that of either *P. torquatus* or *P. nepalensis*.

Lorikeet (*Coryllis vernalis*)

Once, when Jehangir was at Ajmere he narrates that "they brought a bird from the country of Zerbad (Arrakan, Sumatra, etc.) which was coloured like a parrot but had a smaller body. One of its peculiarities is that it lays hold with its feet of the branch or perch on which they may have placed it and then makes a somersault and remains in this position all night and whispers to itself. When day comes it seats itself on top of the branch. Though they say that animals have worship, yet it is most likely that this practise (whispering ?) is instinctive. It never drinks water and water acts like poison upon it, though other birds subsist on water."

A curious observation indeed! In captivity at least the bird drinks freely without dire consequences.

Eagles, Kites, Falcons, etc.

The *Zumej* described by Babur as being of the size of a *burquat* or falcon and of a black colour, may for all we know be the Black Hawk-eagle (*Ictinaëtus malayensis*) as suggested by King. According to the commentator *Zumej* is the Arabic name for *Dubara* or *Du-barādarān* (i.e. "Two brothers") so called because they hunt in couples. He thinks *burquat*, to the size of which the Emperor compares the bird, may be the Golden Eagle (*Aquila chrysaëtus*). In Hindi the Imperial Eagle (*A. heliaca*) is known as *Jūmiz* or *Barājumiz*.

Babur[1] refers to another bird, the *Sar* and all he tells us about it is that "its tail and back are red." I am unable to conjecture what grounds King has for suggesting that it may be the Rosy Pastor (*Pastor roseus*). According to Mrs. Beveridge the word *Sar* in Turki means a buzzard, and this, coupled with the fact that it is included by Babur with his birds of prey, is I think good justification for the alternative surmise that the description may refer to the Brahminy Kite (*Haliastur indus*), a bird held in some esteem by the later Moghuls and looked upon as favourable omen in time of battle.

Abul Fazl, after a brief account of the birds and animals found in Kashmir, goes on[2] to enumerate the various attractions of the country and says: "The people take pleasure in the skiffs upon the lakes, and their hawks strike the wildfowl in mid-air and bring them to the boats; sometimes they hold them down in the water with their talons and stand on them presenting an exciting spectacle."

Fr. Monserrate, the Jesuit already referred to in the foregoing pages, writing about the popularity of the sport of hawking in the reign of the Emperor Akbar states: "The Moghuls are not very fond of hawking. It is regarded however, as a mark of royal dignity for the King to be accompanied on the march by fowlers carrying many birds on their wrists. These birds are fed on crows to save expense." It would appear from another statement of the same writer elsewhere that hunting leopards were much more popular at this period, though Abul Fazl's accounts indicate that both forms were equally in vogue.

Jehangir chronicles[3] that about the year 1618 A. D. an ambassador he had sent to the King of Persia sent him an *āshyāni* falcon. meaning "a bird from the nest"—evidently much prized by falconers. He remarks that in the Persian language, such a bird is known as *Ūknā* (an Arabic word signifying "nest"). "Outwardly" the Emperor observes, "one cannot distinguish between these and the *bāz-e-dāmi* falcons by any particular mark, but after they have been flown the difference is clear."

Bāz-e-dāmi apparently means hawks reared in captivity. It is maintained that birds taken young and trained by man never attain the standard of wild birds trained by the parents.

Whenever the king visited a nobleman at his house, which, as Jehangir puts it, "increased his dignity among his equals and neighbours," it was customary for the host to offer the monarch horses, daggers, hawks and falcons the very best he possessed—which were usually exchanged by the emperor with similar presents.

Describing Kashmir, Jehangir[4] mentions that "among the excellencies (of that Province) are the Hawks (*Janāwar-e-shikāri*). Hawks and Falcons are taken in nets. . . . It has also "nest" (*ukna*) sparrow-hawks (*bāsha*) i.e. taken from the nest and not reared (in captivity) and the nest sparrow-hawk is not bad."

[1] *Babur*, vol. ii, p. 221.
[2] *Ain*, vol. ii, p. 351.
[3] *Jeh.*, vol. ii, pp. 10–11.
[4] *Ibid.*, p. 178.

The information which Abul Fazl furnishes with regard to the prices current for hawks and falcons in the time of Akbar is interesting. The historian writes[1] "From eagerness to purchase and from inexperience, people pay high sums for falcons. His Majesty allows dealers very reasonable profits; but from motives of equity he has limited the prices. The dealers are to get their gain, but buyers ought not to be cheated."

We learn that the hawks were divided into various classes according to their merits, and their prices scheduled accordingly as follows:

First Class—*Khāna kurz*, i.e. Birds that had moulted whilst in charge of experienced trainers and had got new feathers. These *bāz* (hawks) cost 12 *muhurs* (equivalent to 192 rupees). There was also a second grade in this class of falcons.

Second Class—*Chōz*, i.e. Birds that had not yet moulted. The price fixed for this class was 10 *muhurs* (Rs. 160).

Third Class—*Tārinak*, i.e. Birds that had moulted before capture. These were somewhat cheaper than *Chōz*.

It will be seen that the ubiquitous profiteer is not a product of modern times, but that his nefarious activities needed curbing legislation as long ago as Akbar's day!

Green Pigeon

In his avifauna of Hindustan, Abul Fazl mentions the *Harial* (*Crocopus phœnicopterus?*) which he describes as having green plumage, a white bill and crimson irides and as being smaller than the ordinary pigeon.

He states: "It never settles upon the ground, and when it alights to drink it carries with it a twig which it keeps beneath its feet till its thirst is quenched."

This fanciful notion no doubt owes its origin to the exclusively arboreal habits of the bird.

Mons. de Thevenot[2] who visited India during the reign of the Emperor Aurangzebe, writes: "There are pigeons in that country all over green, which differ from ours only in colour: The Fowlers take them with Birdlime in this manner; they carry before them a kind of light Shed or Screen, that covers the whole Body and has holes in it to see through; the Pigeons seeing no man are not at all scared when the Fowler draws near, so that he cunningly catches them, one after another, with a Wand and Birdlime on it, none offering to fly away. In some places Parrocquets are taken after the same manner."

It will be noticed that the method described by the traveller differs little from one in vogue at the present day.

The Pigeon

The Emperor Akbar was a fervent pigeon fancier, and Abul Fazl informs us[3] he kept more than 20,000 pigeons, divided into ten classes at his court.

[1] *Ain.*, vol. i, p. 259.

[2] *Travels into the Levant*, published A.D. 1686.

[3] *Ain.*, vol. i, pp. 298–301.

In reference to these pets, Fr. Monserrate writes : " Not a little is added to the beauty of the palaces by charming pigeon-cotes partly covered with rough cast and partly showing walls built of small blue and white bricks. The pigeons are cared for by eunuchs and servant maids. Their evolutions are controlled at will when they are flying, by means of certain signals, just as those of well-trained soldiery are controlled by a competent general by means of bugles and drums. It will seem little short of miraculous when I affirm that when sent out, they dance, turn somersaults all together in the air, fly in orderly rhythm, and return to their starting point, all at the sound of a whistle. They are bidden to perch on the roof, to conceal themselves within their nesting places and to dart out of them again, and they do everything just as they are told."

This flighting of trained pigeons was known as *Ishqbāzi*.

On the subject of these pets, Akbar's chronicler writes:[1] " In former times pigeons of all kinds were allowed to couple ; but His Majesty thinks equality in gracefulness and performance a necessary condition in coupling and has thus bred choice pigeons. The custom is to keep a male and a female pigeon, if not acquainted with each other, for 5 or 6 days together, when they become so familiar that even after a long separation they will again recognize each other." Further : " At the time of departure and breaking up of the camp, the pigeons will follow, their cotes being carried by bearers (*kūhar*). Sometimes they will alight and take rest for a while and then rise again."

Jehangir makes the following observations concerning Carrier Pigeons.[2]

" It had been stated to me in course of conversation that in the time of the Abbaside Caliphs they taught the Baghdad pigeons, who were styled ' letter carriers' (*nāma-bar*) and were one half larger than the wild pigeon. I bade the pigeon fanciers to teach their pigeons and they taught some of them in such a manner that we let them fly from Mandu in the early morning, and if there was much rain they reached Burhanpur by 2½ *pahars* (watches) of the day, or even 1½ *pahars*. If the air was very clear, most of them arrived by one *pahar* in the day and some by 4 *gharis* of the day."

A *ghari* according to Babur was equivalent to about 24 minutes. Four *gharis* would therefore mean 1 hr. 36 minutes. As the crow flies, Burhanpur is about 100 miles S.S.E. of Mandu in the Central Provinces, and this would make the speed of the birds a trifle over 60 miles an hour. According to Thomson [3] a carrier pigeon can keep up 40 miles per hour for a considerable time, but this will be halved against the wind, and nearly doubled with the wind in the bird's favour. It will be noticed at once how very accurate Jehangir is on this point.

Writing some years later, in the reign of the Emperor Shah-Jehan, Manucci states with regard to pigeons:[4] " The Mohomedans are very keen on breeding pigeons in large numbers ;

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[1] *Ain.*, vol. i, p, 299.
[2] *Jeh.*, vol. i, p. 387.
[3] *A Biology of Birds.*
[4] *Storio do Mogor*, vol. i, p. 107.

they make them fly all together, calling out, whistling and waving with a cloth fastened at the end of a stick, running and making signals from the terraced roofs, with a view to encouraging the pigeons to attack the flock of someone else. In this way the flocks are so trained that they fight in the air. Then when the owners whistle and make the signs above described, the pigeons assemble and fly away to their homes, except a few, who losing their way in the confusion, allow themselves in their innocence to be carried along with their adversaries. It is for this end they fly these flocks, and over and over again they send them out to win more pigeons. Every owner is overjoyed at seeing his own pigeons the most dextrous in misleading their opponents."

Manucci further describes a use to which trained carrier pigeons were put by the nobles of Shah Jehan's court which, being a substitute for the modern telephone, is both amusing and ingenious. Says he,[1] "As I have said the Moghuls rear pigeons for amusement, it is necessary for me to inform the reader how they employ these pigeons to give intelligence if the King leaves his house and comes into the public hall to hold audience. Let the reader be aware then, that these nobles are very pleased not to have to move from home uselessly. Many have their dwellings far from the royal palace, about a league away. They order their retinue to be kept in readiness, first of all having sent to court a servant with two pigeons of different colours.

If the King leaves his house or holds audience, the noble's servant releases one of these pigeons at court and by reaching its home it serves as a messenger. If it is the one that denotes the King's leaving home or sitting in audience, the noble at once rides with his cavalcade in all haste to be present as is his duty. If the other comes it notifies the contrary, the retinue are dismissed and the master takes his ease at home."

The Sand Grouse

Babur includes in his avifauna what he calls *Baghri-kārā* of Hindustan which, he remarks, "is less than the *Baghri-kārā* of the west and slenderer; its cry too is sharper."

King suggests that the Indian bird is probably the Common Sandgrouse (*Pterocles exustus*) and the western species to which it has been compared the Black-breasted or Imperial (*P. orientalis*). In the absence of a description of Babur's bird, any conjecture as to its identity is a difficult one. Perhaps King was acquainted with the Turki name of the bird.

The Peacock (*Pavo cristatus*)

Babur writes[2] at some length about this bird. He says: "The peacock is a beautifully coloured and splendid animal; it is less remarkable for its bulk than for its colour and beauty. Its size may be about that of a crane, but it is not so tall. On the head of the peacock and of the peahen there may be about twenty or thirty

[1] *Storio do Mogor*, vol. ii, p. 467. [2] *Babur*, vol. ii, pp. 214–15.

feathers rising two or three finger-breadths in height. The peahen is neither richly coloured nor beautiful. The head of the male has a lustrous and undulating colour. Its neck is of a fine azure. Lower down than the neck its back is painted with the richest yellow, green azure and violet; the flowers or stars on its back are but small; below they increase in size, still preserving the same colour and splendour down to the extremity of the tail. The tail of some peacocks is as high as a man. Below the richly painted feathers of its tail it has another smaller tail like that of other birds, and this ordinary tail and the feathers of its side are red. It is found in Bajour and Sawād and in the countries below, but not in the Kūner or Lamghānāt or in any place higher up. It flies even worse than the *karkāwel* (pheasant) and cannot take more than one or two flights at a time. On account of its flying so ill, it either frequents a hilly country or a jungle. It is remarkable that wherever there are many peacocks in a wood, there are also a number of jackals in it, and as they have to drag after them a tail the size of a man, it may easily be supposed (? imagined) how much they are molested by the jackals in their passage from one thicket to another. The Hindustanis call it *moor*. According to the doctrines of Imām Abu Hanīfa this bird is lawful food. Its flesh is not unpleasant: it resembles that of the quail but is eaten with some degree of loathing like that of the camel."

The Emperor would appear to share the modern depreciation of the peacock as a bird for the table though in earlier days it was highly esteemed as such. Classical works contain many allusions to its high appreciation at the most sumptuous banquets, and mediæval bills of fare on state occasions nearly always included it. In the days of chivalry one of the most solemn oaths was taken on "The Peacock" which seems to have been served up garnished with its gaudy plumage.

The Jungle Fowl (*Gallus ferrugineus*)

Babur observes [1] that on the outskirts of the hillocks in Dun—the Jaswan or Una Dun—a fertile valley in the Hoshiarpur District "there are many fowls resembling barn-door fowls; they resemble them in shape but are generally of a single colour."

By "single colour" is presumably meant they were not of different or various colours as is the case with domestic fowls.

The Emperor after mentioning it as one of the common birds of Hindustan describes it thus: "The difference between the *mūrgh-e-sahrā* (or 'fowl of the wild') and the barn-door fowl is that the 'fowl of the wild' flies like a *karkāwel* (pheasant); it is not of every colour like the barn-door fowl. It is found in the hill-countries of Bajour and the hill-countries lower down. It is not met with above Bajour."

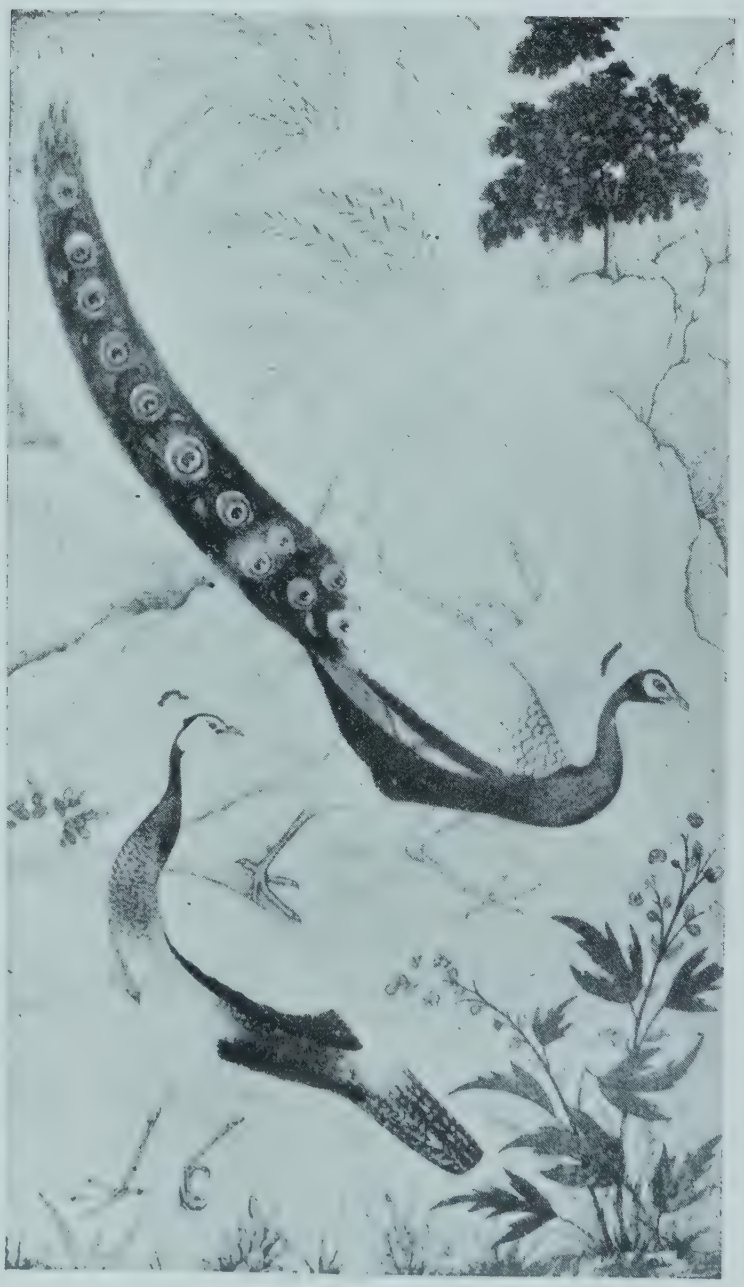
Jehangir notes [1] that this jungle fowl was plentiful in the neighbourhood of the fort of Nūrpur [3] where one day he captured

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[1] *Babur*, vol. ii, p. 173. [2] *Jeh.*, vol. ii, p. 226.
[3] See *Imperial Gazetteer*, new edn., vol. xix, p. 232.



A FALCON.
From a Moghul painting in the Prince of Wales Museum, Bombay.)



PEA FOWL.
(Probably painted by Mansur, *c.* A.D. 1625 ; from the collection of Baron Maurice Rothschild, Paris.)
By courtesy of the Publishers ' Indian Painting under the Moghuls '.—Percy Brown.



A PAIR OF SARUS.
(From a Moghul painting in the Prince of Wales Museum, Bombay.)



CHEER PHEASANT. (Painted probably by Mansur, *c.* A.D. 1625; collection of Baron Maurice Rothschild, Paris.)
By courtesy of the Publishers, 'Indian Painting under the Moghuls'.—Percy Brown.

four birds. He says about them: "One cannot distinguish them in shape and colour from domestic fowls. One of the peculiarities of these birds is that if they are caught by the feet and turned upside down wherever they are taken, they make no sound and remain silent contrary to the domestic fowl which makes an outcry. Until the domestic fowl is plunged into hot water its feathers do not come off easily. The jungle fowl like the partridge or *podna* (quail) can be plucked when dry. I ordered them to roast them. It was found that the flesh of the full-grown ones was very tasteless and dry. The chickens had some juiciness, but were not good to eat. They cannot fly farther than a bow-shot. The cock is chiefly red and the hen black and yellow."

Pheasants

Jehangir remarks that "Of the wild birds they call *Tadru* (Pheasants) till now it has never been heard that they breed in captivity. In the time of my revered father (Akbar) they made great efforts to obtain eggs and young ones, but it was not managed. I ordered them to keep some of them male and female in one place, and by degrees they bred. I ordered them to place the eggs under hens and in a space of two years 60 or 70 young were produced and 50 or 60 grew up. Whoever heard of this matter was astonished. It was said that in the Vilayet (Persia) the people there had made great efforts, but no eggs were produced and no young were obtained."

Elsewhere Jehangir mentions that a certain Zamindar of Tulwara (which according to Abul Fazl was situated in the Bari Doab Sarkar) brought him a bird which the hill people called *Jān-bahān*. "Its tail" he observes, "resembles the tail of the *qurqāwul* (pheasant) which is also called *tazru* (or *tadru* as above) and its colour is exactly like that of a hen pheasant, but it is half as large again. The circle round the eyes of this bird is red while the orbit of the pheasant is white. The said Basoi (the Zamindar) stated that this bird lived in the snow mountains and that its food was grass and other stuff. I have kept pheasants and have reared young ones and have often eaten the flesh of both young birds and mature ones. One may say that there is no comparison between the flesh of the pheasant and this bird. The flesh of the latter is much more delicate."

The bird referred to in the above narrative is no doubt the Cheer Pheasant (*Catreus wallichi*). One of the vernacular names quoted by Blanford is *Chā mān* which may well be a corruption or variation of Jehangir's *Jān-bahān*. As a bird for the table it may be noted that Blanford considers it far inferior to the Koklass.

The Emperor had a sketch of the bird made at the time. The plate—here reproduced—is said probably to be the handiwork of the celebrated animal painter Al Mansur. Though the picture may appear somewhat stiff and "wooden" if judged from the modern Gronvöldian standard, it leaves little doubt as regards the identity of the species.

The Monaul Pheasant (*Lophophorus impejanus*)

Babur [1] mentions the *Lujeh* or *Lukeh* which bird according to him was also called *Būkalemūn*. It is described as follows : " From the head to the tail it has four or five colours. Its neck has a bright glancing tinge like a pigeon's. Its size may be equal to the *Kabk-e-dūrri* (*Tetrogallus caspius*). It may be regarded as the *kubk-e-dūrri* of Hindustan. As the *kubk-e-dūrri* inhabits the summits of mountains, this also inhabits the tops of mountains. They are met with in the country of Kabul and the hill-country of Nijrau and from thence downward, wherever there are hills, but they are not found any higher up."

In a footnote, Sir Lucas King comments on the above as follows: " This may be the Monaul Pheasant (*Lophophorus impeyanus*), though *Bukalemun* is the Persian word for the turkey. The *kabk-e-dūrri* is much larger than the common *kabk* of Persia and is peculiar to Khorasan—*Tetrogallus caspius*. It is said to be a beautiful bird. The common *kabk* of Persia is the Chukor of India (*Caccabis chukor*)."

The present habitat of this bird, which was till not very long ago common about Mussoorie and Simla, is throughout the Himalayas from Bhutan to Kashmir and even further west. The bird has been recorded from Chitral and from the Safed Koh in Afghanistan. It occurs also in Sikkim.

What Jehangir[2] refers to in the following words may also very probably this bird. He says, " Another bird is of a golden (resplendent ?) colour called in Lahore *Shan*. The Kashmiris call it *Put*. Its colour is like that of a peacock's breast. Above its head is a tuft (*kakul*). Its tail of the width of 5 fingers is yellow, and is like the long feather (*Shāh par*) of the peacock, and its body is as large as that of a goose. The neck of the goose is long and shapeless ; that of this one is short and has a shape."

The Tragopan (*Tragopan*, sp.)

Babur[3] describes this pheasant as follows: "Another bird is the *Pūlpeikar* (i.e. ' Flower-faced '). Its size is equal to that of the *kubk-e-dūrri* (*Tetrogallus caspius*). Its figure resembles the dung-hill cock, and in colour it is like the hen. From its forehead down to its breast it is a beautiful scarlet colour. The *Phulpeikar* inhabits the hill-country of Hindustan."

Jehangir[4] describes the *Phulpeikar*—one of the birds he saw in the hill-country (of Kashmir)—which the Kashmiris called *Sonlu*, as follows: " It is $\frac{1}{8}$ less than a peahen. The back, tail and wings resemble those of the bustard, and are blackish with white spots. The breast to the end of the bosom is black with white spots and some red ones. The ends of the feathers are fiery red and very lustrous and beautiful. From the end of the back of the neck it is also brilliantly black. On the top of its head it has two fleshy

[1] *Babur*, vol. ii, p. 216.
[2] *Jeh.*, vol. ii, p. 220.
[3] *Babur*, vol. ii, p. 218.
[4] *Jeh.* vol. ii, p. 220.

horns of a turquoise colour. The skin of its orbits and round its mouth is red. Below its throat there is a skin round it enough to cover the palms of two hands, and in the middle of this the skin is of a violet colour of the size of a hand, with blue spots in the middle. Around it, each streak is of a blue colour, consisting of 8 plumes (?); round the blue streak it is red to the breadth of two fingers like the peach flower, and again round its neck is that blue coloured streak: it has red legs also. The live bird which was weighed came to 152 tolas. (3 lbs. 13 oz.) After it was killed and cleaned it weighed 139 tolas."

Quails

On this subject Babur says: "The *Budineh* (Quail) is not peculiar to Hindustan, but there are 4 or 5 species of it peculiar to that country. There is one species that visits our countries.[1] It is larger and more spreading than the common *budineh* that visits us. Its wings and tail are reddish. This *budineh* goes in flights like the chir (*Catreus walichii*)." The bird referred to is no doubt the Bush Quail (*Perdicula* sp.).

Babur continues: "There is still another species which is smaller than the *budineh* that visits our country. They are generally black on the throat and breast. There is another species which seldom visits Kabul. It is small, somewhat larger than a *kharcheh* (wagtail). In Kabul they call it *Kuratu*."

The former bird is obviously the Rain Quail (*Corturnix coromandelica*) and the latter may be—it is difficult to say—the Lesser Button Quail (*Turnix dussumieri*). The thoroughness with which Babur has dealt with this family of game birds is apparent, and bespeaks an interest and knowledge possessed only by an exceptionally keen observer.

The See-see Partridge (*Ammoperdix griseigularis*)

Writing from camp at the fort of Rohtas (Punjab) Jehangir notes in his diary as follows:—"At this stage *Tihū* were obtained. The flesh of the *Tihū* is better than that of the *kabk*" (partridge or chukor).

It may be mentioned that *Tihu* is still one of the names by which this little partridge is known in some parts.

The Black Partridge (*Francolinus vulgaris*)

The Emperor Babur refers to this bird as the *Durraj*[2] and says "It is not peculiar to Hindustan. It is found everywhere in the countries of the Garmsil[3] but as certain species of it are found only

[1] i.e. the countries north of the Oxus. As suggested by King, this migratory species may probably be the Common Grey Quail (*Coturnix coturnix*). *Babur*, vol. ii, p. 219, footnote.

[2] According to Mrs. Beveridge, *Dūrraj* in Arabic means "one who repeats what he says"; a "tell-tale."

[3] Afghanistan

in Hindustan, I have included it in this enumerative description. The partridge may be equal to the *kabk-e-dūrri* in size.[1] The colour of its beak is like that of the female of the *mūrgh-e-dashti* (Jungle Fowl). Its neck and breast are black, with white spots. On both sides of both its eyes is a line of red. It has a cry of *shīr-dārem-shakrek* ('I have milk and a little sugar'). From its cry it gets its name. It pronounces *shir* short, *dārem-shakrek* it pronounces distinctly. The colour of the hen resembles that of a young *karkāwel* (pheasant). They are found below Nijrau."

Jehangir records having met this bird in the stony country near the village of Bakkar (Sind) in the course of one of his periodical marches to Kashmir about the year A.D. 1620.

The Grey Partridge (*Francolinus pondicerianus*)

What appears very likely to be this bird is described by Babur thus :—" There is another kind of fowl of the partridge kind which they call *kanjel*. It is about the size of a *kabk*. Its cry is very like that of a *kabk* (chukor) but shriller. There is little difference in colour between male and female. It is found in the country of Peshawar, Hashnagar and in the countries lower down but in no higher district."

Abul Fazl mentions that partridges in Kashmir afforded good sport. They were probably hunted with hawks—a form of sport which is still extremely popular in Hindustan.

Jehangir relates that one day while hunting, he saw a *tuyghun* or albino partridge such as he had never before seen, which he caught with a hawk that likewise happened to be an albino. He[2] continues: "I ascertained by trial that the flesh of the black partridge (ordinarily coloured ?) was better than that of the white. . . . "

The Crane

Jehangir describes a *Kulang*[3] hunt with falcons, a sport, he states, of which his son Shah Jehan was particularly fond. The birds employed on this occasion were *Shāhīn* (either *Falco peregrinator* or *F. barbarus*) He relates : " At Shah Jehan's request I rode out early in the morning and caught one *dūrna* (crane) myself whilst a falcon my son had on his wrist caught another. Certainly of all good hunting amusements this is the best. I was exceedingly pleased with it. Although the Sarus is large, it is lazy and heavy on the wing. The chase of the *dūrna* has no resemblance to it. I praise the heart and courage of the falcon that can sieze such strong bodied animals, and with the strength of his talons subdue them. Hassan Khan, chief huntsman of my son was honoured with an elephant, a horse and a dress of honour as a reward for his exhibition of sport, and his son also received a horse and a dress of honour."

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[1] Apparently here only *kabk* (chukor) is meant, as we have been told above that the *kubk-e-dūrri* is the size of the Monal Pheasant.

[2] *Jeh.*, vol. ii, p. 284.

[3] Either *Grus communis* or *Anthropoides virgo*.

The Emperor records[1] that once while hunting waterfowl in Kashmir, a boatman caught and brought him a young Demoiselle Crane (?)

"It was very thin and miserable" continues the royal naturalist, "It did not live longer than a night. The *qarqarā* (Demoiselle Crane ?—perhaps from its cry) does not live in Kashmir. This had became ill and thin at the time of coming from, or going to Hindustan and had fallen there."

The last passage would tend to indicate that the Emperor was well acquainted with the fact of bird migration.

The Sarus Crane (*Grus antigone*)

Babur[2] describes this bird as follows: "The Turks who are in Hindustan call the Sarus *Tiweh tūrneh* (Camel crane). It is a little less than the *ding* (Adjutant). Its head is red. They keep it about their houses and it becomes very tame."

Jehangir appears to have entertained a special regard for this bird, concerning which his observations and notes are particularly exhaustive. The reputed devotedness of the pair to one another and their attachment to their young seems to have particularly arrested his fancy. He relates that once when encamped in the neighbourhood of Deogaon (Gujerat) one of his eunuchs caught two young sarus on the bank of a large tank hard by. "At night" he notes, "two large sarus appeared making loud cries near the *ghusal khana* (lit. 'Bath-chamber') which they had placed (erected) on the edge of the tank, as if somebody were exercising oppression on them. They fearlessly began their cries and came forward. It occurred to me that certainly some kind of wrong had been done to them, and probably their young had been taken. After enquiry was made, the eunuch who had taken the young sarus brought them before me. When the sarus heard the cries of the young ones, they without control threw themselves upon them, and suspecting they had had no food, each of the two sarus placed food in the mouths of the young ones and made much lamentation. Taking the young ones between them, and stretching out their wings and fondling them, they went off to their nest."

The Emperor has recorded some extremely useful and interesting notes concerning the breeding habits of the sarus, from pairing onwards, to the time the young were hatched, which I think deserve to be quoted *in extenso*. They bespeak the keen and lively interest of the writer in his subject, and their minuteness and accuracy are such as would do justice to any modern work on Natural History.

He writes:[3] "At this time the pairing of the sarus which I had never before seen, and is reported never to have been seen by man, was witnessed by me. The sarus is a creature of the crane genus, but somewhat larger (*dah dūwazdeh*, lit., ten, twelve, i.e. its is $\frac{1}{5}$ larger). On the top of the head it has no feathers, and the skin is drawn over the bones of the head.

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[1] *Jeh.*, vol. ii, p. 176. [2] *Babur*, vol. ii, p 220.
[3] *Jeh.* vol. ii, p. 16.

From the back of the eye to six fingers breadths of the neck it is red. They mostly live in pairs on the plains, but are occasionally seen in flocks. People bring a pair from the fields and keep them in their houses and they become familiar with men. In fact there was a pair of sarus in my establishment to which I had given the names of Laila and Majnun (the 'Romeo and Juliet' of Persian story and song). One day a eunuch informed me that the two had paired in his presence. I ordered that if they showed an inclination to pair again they should inform me. At dawn he came and told me that they were about to pair again. I immediately hastened to look on. The female having straightened its legs, bent down a little : the male then lifted one of its feet from the ground and placed it on her back, and afterwards the second foot, and immediately seating himself on her back paired with her. He then came down, and stretching out his neck, put his beak on the ground and walked once round the female. It is possible they may have an egg and produce a young one. Many strange tales of the affection of the sarus for its mate have been told. The following case has been recorded because it is very strange. Qiyam Khan, who is one of the *Khanzadas* (house-born ones) of this court, and is well acquainted with the arts of hunting and scouting, informed me that one day he had gone out to hunt and found a sarus sitting. When he approached, it got up and went off. From its manner of walking he perceived signs of weakness and pain. He went to the place where it had been sitting. He threw a net round it and drew himself into a corner, and it tried to go and sit in the same place. Its foot was caught in the net and he went forward and siezed it. It appeared extremely light, and when he looked minutely he saw there were no feathers on its breast and belly ; a handful of feathers and bone came into his hand. It was clear that its mate had died, and that it had sat there from the day it lost its companion. Himat Khan, who is one of my best sevants, and whose word is worthy of reliance, told me that in the Dohad Parganna (Gujerat) he had seen a pair of Sarus on the bank of a tank. One of his gunners shot one of them and in the same place cut off his head and stripped it of its feathers. By chance we halted two or three days at that place, and its mate continually walked round it and uttered cries of lamentation. 'My heart,' he said, 'ached at its distress but there was no remedy for it save regret.' By chance, twenty-five days afterwards he passed by the same spot and asked the inhabitants what had become of the sarus. They said it died on the same day and there were still remains of feathers and bones on the spot. He went there himself and saw it was as they said. There are many tales of this kind among the people which it would take too long to tell."

A few days later, Jehangir continues his diary : ". . . . the sarus, pairing of which has been related in the preceding pages, collected together some straw and a little rubbish in the little garden and laid first of all one egg. On the third day after this it laid a second egg. This pair of sarus were caught when they were about a month old and had been in my establishment five years. After 5½ years they paired and continued doing so for a month ; on the

21st of the month of Amurdad, which the Hindus call Savan (*Shravan*: August-September) the hen laid the eggs. The female used to sit on the eggs the whole night alone, and the male stood near her on guard. It was so alert that it was impossible for any living thing to pass near her. Once a large weasel (mungoose) made its appearance and he ran at it with the greatest impetuosity and did not stop till the weasel got into a hole. When the sun illuminated the world with its rays the male went to the female and pecked her back with his beak. The female then rose and the male sate in her place. She returned and in the same manner made him rise and seated herself. In short the female sits the whole night and takes care of the eggs and by day the male and female sit by turns. When they rise and sit down, they take great precautions that no harm shall come to the eggs.'

The Emperor continues his observations as follows: "From Sunday 3rd till the eve of Thursday the 7th rain fell. It is strange that on other days the pair of sarus sate on the eggs five or six times in turns, but during this 24 hours when there was constant rain and the air was somewhat cold the male, in order to keep the eggs warm, sate from early in the morning till mid-day, and from that time till the next morning the female sat without an interval for fear that in rising and sitting again, the cold air should affect them and the eggs become wet and be spoilt. Briefly, men are led by the guidance of reason, and animals according to Divine Wisdom implanted in them by Nature. Stranger still is it that at first they keep their eggs together underneath their breast, and after 14 or 15 days have passed they leave a little space between them for fear that the heat should become too great from their contact with each other. Many become addled in consequence of (too great) heat."

Further, "On the eve of Thursday the 21st the sarus hatched one young one, and on the eve of Monday the 25th a second; that is, one young was hatched after thirty-four days and the other after thirty-six days (from the time the first egg was laid or also thirty-four days for this). One might say that they were $\frac{1}{10}$th larger than the young of a goose, or equal to the young of a peafowl at the age of a month. Their skin was of a blue colour. On the first day they ate nothing and from the second day the mother taking small locusts (grasshoppers) in her mouth sometimes fed them like a pigeon, or sometimes like a fowl threw them before them to pick up of themselves.

If the locusts were small it went off well, but if they were large she sometimes made two or three pieces of it so that the young ones might eat it with ease. As I had a great liking for seeing them I ordered them to be brought before me with every precaution that no harm might happen to them. After I had seen them I ordered them to be taken back to the little garden inside the royal enclosure, and to be preserved with the greatest care, and that they should be brought to me again whenever they were able to walk."

The diary continues a few days later: " . . . . At first the male sarus used to hold its young one by its leg upside down in its beak, and there was a fear that he may be unkind to it and it might be

destroyed. I had accordingly ordered them to keep the male separately and not allow it near its young ones. I now ordered by way of experiment that it should be allowed near them, that the real degree of its unkindness or affection might be ascertained. After allowing it, it displayed much attachment and kindness, and his affection was found to be no less than that of the female. I thus knew that this performance was out of real love."

Further on, the following entry made at Agra (?) appears: "The pair of sarus that had had young ones had been brought from Ahmedabad on Thursday the 25th. In the court of the royal enclosure which had been placed on the bank of a tank, they were walking about with their young ones. By chance both the male and the female raised a cry and a pair of wild sarus hearing it, and crying out from the other side of the tank, came flying towards them. The male with the male and the female with the female engaged in a fight and although some people were standing about the birds paid no heed to them. The eunuchs who had been told off to protect them hastened to sieze them. One clung to the male and the other to the female. He who had caught the male kept hold of it after much struggling, but the one who siezed the female could not hold her and she escaped from his hand. I with my own hand put rings in its beak and on his legs and set him free. Both went and settled in their own place; whenever the domestic sarus raised a cry they responded."

The Great Indian Bustard (*Choriotes edwardsi*)

"The *Kharchal*" (or Bustard) according to Babur 'which may be about the size of a *tughdak* is in reality the *tughdak* of Hindustan. Its flesh is very savoury. The flesh of the leg of some fowls and of the breast of others is excellent; the flesh of every part of the *kharchal* is delicious."

The real *tughdak* it would appear is the Great Bustard (*Otis tarda*) with which Babur seems familiar from his Central Asian home. The Indian bird above referred to is no doubt the Great Indian Bustard, which in some parts of India is known as *Tughdar* or *Tuqdar*, a possible corruption of the original *tughdak*, as suggested by King.

The Florican

Babur says:[1] "The size on the *Charz* is somewhat less than a *tughdari*. The back of the male is like that of the *tughdari*; its breast is black. The female is of a single colour. The flesh of the *charz* is very delicate. As the *kharchal* resembles the *tughdak*, the *charz* resembles the *tughdari*."

This bird can be either the Likh or Lesser Florican (*Sypheotis auritra*) or the Bengal Florican (*Sypheotis bengalensis*). Most probably, however, the reference is to the latter species as it seems hardly credible that the peculiar elongated feathers of the upper throat and ear coverts of the former bird, should have escaped mention at the hands of a keen naturalist like Babur. From the fact

[1] *Babur*, vol. ii, p. 219.

that no description of the *tughdari* is furnished it may be concluded that this bird also (undoubtedly the Houbara—*Chlamydotis undulata macqueeni*) was familiar to the Emperor and his readers at home.

Writing of this bird, Jehangir [1] says: "I formerly thought that there were two species, one a mottled black and the other *bur* (a kind of dun colour). I now discovered that there are not two kinds but that which is a mottled black is the male and that which is dun coloured is the female. The proof is that in the piebald there are testicles and in the dun one there are eggs (ovaries). This has repeatedly been found on examination."

Jehangir's personal research is laudable, but it seems strange that though Babur recognized at first that "the female is of a single colour" his naturalist great-grandson should have made this discovery only at a comparatively late stage.

The Emperor further observes as follows: "It is a strange thing that the windpipe in all animals (*haiwanat*) which the Turks call *hulq*, is single from the top of the throat to the crop (*china-dan*), while in the case of the *charz* it is different. In this case it is four fingers breadths from the top of the throat single and then it divides into two branches and in this form reaches the crop. Also at the place it divides into two branches there is a stoppage (*sar-band*), and a knot (*girih*) is felt by the hand."

I do not know what peculiarity Jehangir is referring to. I can find no mention anywhere of anything extraordinary in regard to this part of the florican's anatomy.

The White Ibis (*Ibis melanocephala*)

Another bird, which Babur calls the White Buzek, is no doubt this species. Its Hindi name is *Safed baza*. The Emperor says: "Its head and bill are black. It is considerably larger than the *buzek* of our country [2] but less than the *buzek* of Hindustan." [3]

Another species of Ibis is also described by Babur which I am unable to place.

The White-necked Stork (*Dissoura episcopa episcopa*)

Babur [4] observes: "There is another sort of stork which has a white neck while the head and all the rest of its body are black. It migrates to our countries. It is rather less than the common stork. This stork the Hindustanis call *Yakding*."

King suggests that this may be the Painted Stork (*Pseudotantalus leucocephalus*). I do not see precisely what justification he has for doing so, as the description appears to fit this species much better though it must be admitted that the underparts of our bird have a considerable amount of white in them.

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[1] *Jeh.*, vol. ii, p. 292.

[2] Which according to Mrs. Beveridge may be *Plegadis falcinellus*, the Glossy Ibis, a winter visitor to most parts of India.

[3] King suggests that by this last may be meant the Spoonbill (*Platalea leucorodia*) called in India *Chamach-buzek*.

[4] *Babur*, vol. ii, p. 220.

The Adjutant Stork (*Leptoptilus dubius*)

Babur[1] writes: "One of the fowls that frequent the water and banks of rivers in the *Ding*, which is a large bird. Each of its wings is the length of a man; on its head and neck there is no hair. Something like a bag hangs from its neck; its back is black, its breast white; it frequently visits Kabul. One year they caught and brought me a *ding* which became very tame. The flesh which they threw it, it never failed to catch in its beak, and swallowed without ceremony. On one occasion it swallowed a shoe well-shod with iron: on another occasion it swallowed a good sized fowl right down, with its wings and feathers."

The Emperor also records the popular superstition, prevalent even in his day, that if you split the head of an Adjutant before death, you will extract from it the celebrated *Zahir mohra* (Poison-killer) or "Snake stone" of great virtue and repute and a potent antidote against all kinds of poison.

The Painted Stork (*Pseudotantalus leucocephalus*)

Babur describes this bird as "nearly the height of a sarus, but its size is less. It resembles the stork (Lalag—*Ciconia alba*) but is much larger. Its bill is longer than a sarus's and black. Its head is polished and shining, its neck white, its wings parti-coloured. The edges and roots of the feathers of its wing are white and the middle black."

Both King and Mrs. Beveridge are of opinion that this may be the White-necked Stork (*Dissura episcopa*). From the clue however that its head is "polished" (although the bill certainly is not black) it is possible that the Painted Stork is meant. Babur is unmistakably clear in other places when describing shine or gloss of feathers (cf. Pigeon and Monal Pheasant) and the word rendered as "polished" by the translators would appear to indicate the bare facial skin of this bird which extends back to the crown. The description of the plumage, moreover, points more to its identity as this rather than to the species suggested by King and Mrs. Beveridge. Babur called the bird *Minkisa*.

The Open Bill (*Anastomus oscitans*)

The bird described by Babur as follows may be this species: "It resembles in colour and shape the stork that visits our countries. Its beak is generally black and white, and is much smaller than the other."

Egrets

In view of much recent interest and the proposed legislation for licensing egret farms in Sind and elsewhere so as to make it a commercially profitable industry without detriment to the birds producing the plumes, it is interesting to read Abul Fazl's account[2] relating to the Sarkar of Kashmir where he says: "In the village of Matalhamah is a wood which is a heronry. The heronries are

[1] *Babur*, vol. ii, p. 220.

[2] *Ain.*, vol. ii, p. 362.

strictly guarded and in the Spring when their long feathers fall from their necks, there is a watchman in attendance who picks them up. The feathers are taken for plumes and the birds here are regularly fed."

Jehangir remarks that " among the excellencies of Kashmir are the plumes of feathers (*kalgi*) " presumably from these very heronries, " of which as much as 10,700 feathers are yearly obtained."

The Nukta or Comb Duck (*Sarcidiornis melanonotus*)

Babur's *Shah-mūrgh* described as follows, is obviously this duck. " There is another waterfowl which they call *Shah-mūrgh*. It may be rather less than a goose. It has a swelling above its nose. Its breast is white, its back black and its flesh is excellent."

The Spot-billed Duck (*Anas pœcilorhyncha*)

Babur describes a species of duck as follows : " There is a waterfowl which they call *Gheret-pai*. It is larger then the *Sona-burchin*. The male and female are of the same colour. It is always found in Hashnagar and sometimes visits the Lamghanat. Its flesh is very delicate."

In a footnote, Sir Lucas King suggests that this may be the Spot-billed Duck, which is called *Garm-pai* by the falconers. *Sona* according to him is the name for the Mallard. Mrs. Beveridge in her translation of Babur's *Memoirs*, renders the word as *Gharm-pai* and remarks that Dr. Ross' notes from the " Sanglakh " that *Suna* is the drake and *Burchin* the duck of *Anas boscas*, and that it is common in China to call a certain variety of bird by the combined sex names. This practice, it may be mentioned, is frequently adopted in India also, thus *Chakwa-chakwi* is the name by which the Brahminy Duck (*Casarca rutila*) goes in many parts of the peninsula.

(*To be continued*)

THE BIRDS OF BRITISH BALUCHISTAN

BY

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PART III

(With a plate)

(Continued from page 881 of Volume XXXI)

Tyto alba javanica (Gmel.) The Indian Barn Owl.

Murray says he obtained the White Owl at Siri Bolan in the Pass on May 18, 1880. W. D. Cumming informed me that one was seen about the Telegraph Station at Ormarra for a week in March 1902. No other record. Possibly a rare resident.

Asio otus otus (L.) The Long-eared Owl.

The Long-eared Owl is a rare vagrant in the north; one was obtained at Quetta on December 2, 1908 and Murray records it also from the Quetta Valley. Hutton and St. John both obtained it at Kandahar.

Asio flammeus (Pont.) The Short-eared Owl.

A winter visitor in small numbers, the Short-eared Owl has been obtained on several occasions in the Quetta Valley, Mach, Gulistan and Fort Sandeman between January 10 and April 21.

In the Mekran Hotson met with it twice, in the Hingol Valley on September 3 and at Dizak on November 18; probably scarce. I saw one on the Sind side of the Habb River on November 14.

Strix aluco biddulphi, Scully. Scully's Wood Owl.

Col. Venning obtained this owl on January 10, at Old Shinghar in the Zhob Valley; the specimen is in the Bombay Museum. No other record. ? Rare resident in extreme N.E.

Strix butleri (Hume.) Hume's Owl.

The type of the species was collected in Mekran by Nash for Butler; it is in the British Museum. Nash was for many years stationed at Ormarra and so possibly this bird came from there.

This Owl, which was described by Hume in 1878, has never been met with there since. There is in the Liverpool Museum an earlier bird obtained by Claude Wyatt in Sinai in 1864. In the *Ibis* 1870 Wyatt no doubt refers to this Owl as *Phasmoptynx capensis*; he says one of his men was working at the ruins of Feiran when he saw this owl looking out of a hole in the wall and by closing the hole with a stone he captured it. This was the only specimen Wyatt got though he heard what was apparently this species in the Wadi Hebran and 'perhaps half a dozen times in the Peninsular.' This was in January. In September 1911 Schrader heard this owl in the Wadi Feiran and on the 23rd obtained one which was so blown to pieces that only parts, just sufficient for identification, could be preserved. A fourth example was obtained by Philips in the Wadi Feiran on March 31, 1914. (*The Auk*, 32, p. 282 and plate). Probably too it was this Owl which Kaiser got in August 1891 and July 1892 in the Wadi Bedr and in the Wadi Arka on March 31, 1893. (*Le Roi Jour. f. Orn.*, 1923, pp. 65–66). It seems clear then that this Owl's home is the Sinai peninsula where it is evidently not uncommon though perhaps very local and that it is resident there. How comes it then that Nash got it on the Mekran coasts? ; it seems unlikely that it is a normal resident there. Cumming tried at various places there for years and did not come across it and other naturalists—Blanford, Zarudny, Zugmayer, Hotson—all failed to meet with it. If it is very local and also very scarce it yet may have possibly eluded all these people. On the



HANNA PASS, QUETTA.
BARE HILLS BELOW JUNIPER LEVEL, A FAVOURITE



A VENERABLE JUNIPER. ZIARAT FOREST.

other hand cyclones occur sometimes on this coast and bring birds which are not usually met with and this may account for its occurrence but even then one must suppose it occurs somewhere in Arabia nearer than Sinai. Unfortunately there are no details of the capture of this bird at Ormarra.

Bubo bubo turcomanus (Evers.) The Turkestan Eagle Owl.
'Boom', Bal.

The Eagle Owl is resident and sparsely distributed in the hills of N. Baluchistan. Marshall received a young one taken from the nest and there are two half grown young in the Quetta Museum taken near there on June 3, 1915, where there are also three adults. It has been obtained at Khozdar in S. Kalat and at Kandahar. Besides those in Quetta Museum I have examined three in the British Museum obtained at Quetta, Kandahar, and Kalat and they appear to be typical *turcomanus* which is very near *ruthenus*—W. 450–460 mm.

Neither *Bubo bengalensis* nor *Bubo coromandus* are recorded from Baluchistan but I have seen the former between Karachi and the Baluch boundary.

Otus scops pulchellus (Pall.) The Eastern Scops Owl.

The distribution and status of the three species of Scops Owl is not clear and there are very few records of any of them. It seems fairly clear however that this Scops Owl is a summer visitor in small numbers and locally distributed in N. Baluchistan. It apparently arrives about the middle of April. St. John says it is common in the juniper hills and Swinhoe records it (as *pennatus*) in the orchards at Kandahar. I have examined specimens obtained at Chaman on April 16, at Kandahar on April 11 and 12 and a half-grown young one from Ziarat on July 2. Murray records this bird in several places between Quetta and Kandahar and says *pennatus* (rectius *sunia*) occurs at Mach, Dozan and Quetta, however there are no specimens to bear this out or that the Indian Scops Owl occurs at all in Baluchistan.

The only record from the south is from Ormarra on the coast where Cumming obtained one on passage in September.

Otus brucei (Hume.) The Striated Scops Owl.

The Striated Scops Owl must be resident (or a summer visitor) in small numbers. I have seen one (in British Museum) from Chaman obtained on April 23 and also a half-grown young one from the same place on June 6. These are the birds recorded by Barnes and St. John. One from Toba Achahzai obtained in June is in the Bombay Museum and W. D. Cumming sent me a full grown young one from Sheik Mandah on August 16, 1923.

In Central Mekran Hotson obtained one at Shireza Patk (Kharan) on the Panjgur-Kalat road.

Otus bakkamœna deserticolor (Ticehurst.) The Desert Collared Scops Owl.

The only certain record is a bird obtained by Murray (now in British Museum) at Killi Abdullah (5,100 ft.) on the road from Quetta to the Khojak on May 3, 1880, where it must have been breeding.

Scops Owls (? this) are said to occur in Las Belas.

Athene brama indica (Frankl.) The Indian Spotted Owlet.

Meinertzhagen obtained two specimens at Quetta on April 6 and June 7. Swinhoe says it is common in the lower parts of the Bolan but he did not find it west of Mach; he obtained an adult and a young bird at Pir Chowki at the entrance on May 15. Murray, on the other hand, says it is found as far as Gulistan and is replaced beyond the Khojak by *bactriana*. The distribution is not quite clear but it can be safely said that this owl comes up as far as Quetta where it breeds and is resident. Common at Sibi in the plain.

It is fairly common throughout the Makran in suitable places and is resident; it occurs as far west as Bampur in Persian Baluchistan and Hotson obtained it far as north in the Makran as Gajar in the Mashkai valley.

Athene noctua bactriana (Hutton.) Hutton's Little Owl.

The Little Owl is fairly common and resident over the whole of N. Baluchistan inhabiting banks, rocks, old walls, etc. Barnes records young in a hole in a tree on June 3 at Chaman while at Kandahar Swinhoe found several nests with young in the fort walls early in April. I have examined numerous adults and young in the Quetta Museum obtained in that district. It apparently does not occur in the Bolan, and it is curious that St. John does not refer to it in

Kalat as it certainly occurs, as Hotson obtained it at Surab in S. Kalat on July 1.

In the Makran there are no records of it but Hotson obtained it at Magas just over the Persian boundary on December 3, where he says it was scarce.

Pandion haliaetus haliaetus (L.) The Osprey.

It is remarkable that there is no record of the Osprey in N. Baluchistan. On the Makran coast it is common enough in winter and according to W. D. Cumming it is found throughout the year but he had no evidence of its breeding there, though there is no reason why it should not do so in such places as Ormarra Head, as it certainly breeds at the eastern end of the Persian Gulf. On the other hand non-breeding birds may be seen on the Sind coast all through the hot weather.

Ægypius monachus (L.) The Cinereous Vulture.

The Black Vulture is resident in small numbers throughout the higher hills of the north (8,000–10,500 ft). The huge nest is nearly always built in the top of a large juniper, a single egg in March or early April is laid, though a much incubated egg is recorded in May. In winter it spreads out to the lower plains and valleys and so reaches Sibi and Kandahar.

It wanders to the Makran coast where Cumming has noted it in the hills near Ormarra but its status in S. Baluchistan is not known.

Gyps fulvus fulvescens (Hume.) The Griffon Vulture.

The earlier writers considered the Griffon to be less common than the Black Vulture but the concensus of opinion now seems to be that it is the commoner of the two in N. Baluchistan. It is resident and breeds at the higher elevations. Betham records an egg on April 5 and Marshall one young hatched on April 25. It is a cliff breeder. During the Afghan War of 1879 Swinhoe noted that vultures became much commoner than before.

Probably a winter visitor to the Makran coast ; Cumming has noted it at Ormarra ; status elsewhere not known, but almost certainly breeds in the Khirthar Range.

Gyps himalayanus (Hume.) The Himalayan Griffon Vulture.

A bird in Quetta Museum obtained at Quetta on February 10, appears to be a young bird of the species. A wanderer ?

Pseudogyps bengalensis (Gmel.) The Indian White-backed Vulture.

St. John records that in 1878 the White-backed Vulture followed the troops marching from Sukkur to Afghanistan, profiting by the numerous dead animals left *en route*. The laying of the railway across the Sibi plain in 1879 depriving them of food on the first part of the journey, they disappeared. Murray however records it at both ends of the Bolan Pass in 1880. There are no recent records of this ' Plains ' bird, nor did I meet with it even at Sibi in December.

It wanders to the Habb Valley doubtless from Karachi where it is common and may go further into Las Belas but I have no record of it from anywhere else in Makran ; but Zarudny lists it as a breeding species in Persian Baluchistan.

Neophron percnopterus percnopterus (L.) The Egyptian Vulture.

The Neophron is a very common summer visitor to the hills of N. Baluchistan arriving at the beginning of March. It appears to breed all through the higher hills ; young are recorded as hatched at the end of April and both cliffs and trees are utilized as nesting sites. The birds have left the hills by September and young appear in the Quetta valley by the end of July, in which locality and others of similar altitude some birds may be seen into November. It is common in the Sibi plain in winter.

Throughout Central and Coastal Makran it is probably more or less resident ; it breeds round Ormarra in March making its nest usually on a ledge near the top of the lower hills and difficult of access ; fresh eggs were found by Cumming on March 1 and March 31.

Zarudny and Härms described the Neophron from S. Persian Baluchistan as *N. percnopterus rubripersonatus* (Orn. Monats., 1902, p. 52) differing from the

typical race in having the bare parts of the head orange-red instead of yellow. W. D. Cumming who found Neophrons common at Charbar in 1920 paid particular attention to this point at my request and sent me a description and water colour painting of birds examined at close quarters and he added that he could see no difference between these Charbar birds and Karachi ones, and judging by the painting and description I agree. He never saw any with orange-red on the head. Zarudny's race cannot be, I think, a good one and must be founded on stained birds.

Gypaetus barbatus grandis Storr. The Lammergeier.

One of the ornithological sights of N. Baluchistan is the quantity and tameness of the Bearded Vultures. It is a constant resident and breeds in all the higher hills from the Suleimans westward. It lays early in March, the nests being on ledges of (mostly) inaccessible cliffs. It is common in the Bolan Pass but does not reach the Sibi plain. Round Quetta it is distinctly a scavenger and attends at carcasses with Neophrons and ravens and may be seen often enough right in the Cantonment swooping round low down in search of morsels; Meinertzhagen records attempts of one to carry off a puppy from a barrack room verandah! At Ziarat, too, I have had this magnificent bird sailing round within few feet of my head.

Not recorded in central and coastal Makran.

Aquila chrysaetus daphanæ (Menzb.) The Golden Eagle.

Locally in the higher hills of N. Baluchistan the Golden Eagle is not uncommon and is resident, wandering to the lower valleys in winter. At Ziarat in the autumn one or two of these magnificent birds were seen almost daily soaring high overhead. Radcliffe records that a young one taken from an eyrie was sent to the Karachi Zoo and that he received an egg taken by natives which was thought to be of this species. Marshall too had eggs brought to him and saw an eyrie and obtained an adult. They hunt in pairs for Chukar and readily take wounded birds; Meinertzhagen records that one even swooped on a covey and took a bird on the wing. In the Quetta Museum are specimens from Quetta on January 29, and Harboi August 30 and I have a young one just out of the nest picked up dead near Quetta in my collection.

No record in S. Baluchistan for I am doubtful if the bird recorded by Hume at Gwader on February 18 could belong to this species.

Aquila heliaca (Savigny.) The Imperial Eagle.

Swinhoe records the Imperial Eagle as common in winter at Kandahar whence there are specimens in the British Museum; it is therefore rather surprising that there are no records of it in Baluchistan except Murray's statement that Dupuis collected several at Quetta on May 2, 1880 and July 7, 1888.

Aquila nipalensis nipalensis (Hodg.) The Steppe-Eagle.

Hotson obtained a Steppe-eagle at Hazarganji in the valley of the Dhor (Hingol R.) Jhalawan on September 19.

No other record; scarce winter visitor?

Aquila rapax vindhiana (Frankl.) The Indian Tawny Eagle.

Meinertzhagen records that the Tawny Eagle is not uncommon in the plains of N. Baluchistan between February and September; a local specimen obtained on July 22 is in the Quetta Museum.

Hotson obtained one at Gidar in S. Kalat on June 29; I have seen it in the Habb Valley in June and Cumming says it is occasionally seen at Ormarra from October to May. How much further west it occurs is not known. Nor is its status clear; Zarudny lists it as nesting in Persian Mekran.

Aquila clanga (Pall.) The Greater Spotted Eagle.

The Spotted Eagle should be commoner than records indicate. Murray records it at Siriab in March, at Nuskhi and at Kirta on May 22! Cumming obtained one at Ormarra on October 29.

No other records.

Heraetus fasciatus (Vieill.) Bonelli's Eagle.

Bonelli's Eagle is doubtless resident in small numbers throughout Baluchistan. Marshall records nests in the Quetta district with one egg on May 14 and with two eggs on May 26. Meinertzhagen noted several at Ziarat in July.

Cumming informed me that it is resident at Ormarra on the Mekran coast and breeds there in January whence there is a specimen in Bombay Museum.

Hieraetus pennatus (Gmel.) The Booted-Eagle.

The Booted Eagle is not uncommon in Kalat and the Quetta Valley to the Khojak whence it is recorded by St. John, Murray, Meinertzhagen and seen by myself. The records range from March to August so it is apparently a summer visitor. No nesting records.

Duke obtained it at Nal in S. Kalat on May 18 but there are no certain records from Mekran.

Circaetus gallicus (Gmel.) The Short-toed Eagle.

All there is on record concerning the Short-toed Eagle is St. John's statement that it is not uncommon in Kalat and S. Afghanistan; there is a specimen of his in the British Museum from Kandahar obtained o August 24.

Butastur teesa (Frankl.) The White-eyed Buzzard.

Radcliffe records that the White-eyed Buzzard is fairly common in the Quetta Valley in winter, not seen in summer; but St. John's records one obtained in Quetta in the summer of 1887. I think it must be only a wanderer up to that district.

All through Central Mekran and as far north as Baghwana, N. of Khozdar, it is resident or at the most a local migrant. In coastal Mekran too from Las Belas to Gwader and on to Charbar and Jask in Persian Mekran it is fairly common and is said to occur as far west as Bunder Abbas. Cumming found a nest with three eggs at Jask on April 15 and he informs me that a bird at Charbar attacked a brown dove which had accidentally got under some netting, and he has seen one try to catch a sparrow.

Haliaetus leucoryphus (Pall.) Pallas' Fish Eagle.

There is very little information as regards Pallas' Fish Eagle; Barnes records an egg which he supposed to be of this species, which was brought to him at Chaman on March 18.

It occurs at Ormarra between December and April according to Cumming, but he did not know whether it bred there.

Haliaetus albicilla (L.) The White-tailed Eagle.

Only recorded from the Mekran coast where Blanford saw it at Gwader in December and Hume in February. Cumming has seen it at Ormarra occasionally in winter and I saw a magnificent adult bird at the Habb River on November 14.

There are no records in the north. I have no certain record of *Haliastur Indus* in Baluchistan but it is almost certain to occur at least in Las Belas. Murray lists it without comment.

Milvus migrans migrans (L.) The Black Kite.

The Black Kite is a fairly common summer visitor to N. Baluchistan. Barnes says it arrives at Chaman early in the spring and breeds at the end of March; Marshall obtained eggs in the hills near Quetta on April 12, and Meinertzhagen found young in Murdan on May 4. Other breeding places mentioned are Khojak, Kushnob and Ziarat. It would seem that this race replaces *govinda* in the higher hills but the distribution of both wants further working out. It is said to visit the Quetta Valley on passage and I found all had left Ziarat by the third week in September. Five adults examined—Chaman, Quetta, Khawash, and 'S. Afghanistan' appear to be typical *migrans*. Whether it breeds throughout Kalat and at all in Central Mekran is not known; Hotson obtained one in Panjjur District on April 1, and I saw one at sea off Gwadar on March 13, so that some must pass through W. Mekran on passage.

Milvus migrans govinda, Sykes. The Pariah Kite.

Most observers are agreed that the Indian race is resident and breeds in the Sibi plain, Quetta valley, north to Pishin. Meinertzhagen says a number visit

the Quetta valley too from the south during the rains ; this would be when young are on the wing. It breeds in April. Some may leave in the winter as Marshall noted they were scarcer at that season. Swinhoe records *migrans* from Kandahar on February 14, 1881, but this specimen, an adult, is in the British Museum and I consider it to be, by its *brown* streaked head, *govinda*, as may be also a young one thence on November 17. The status at Kandahar is not certain as many kites wandered thither during the Afghan War.

At that time our knowledge over the rest of Baluchistan is not at all full. This Kite is common and resident in the Habb Valley and probably too in the Las Belas plain ; Cumming says it wanders to Ormarra in winter, Blanford noted that kites were scarce in West Coastal Mekran at the end of January but he unfortunately obtained no specimens. Hotson too unfortunately got none there and made no notes concerning the species which however he met with at Ornach in the Hingol Valley (E. Central Mekran) in September and obtained a specimen. The status, if it occurs at all throughout Mekran, needs working out, though Zarudny lists it as a rare breeding species in Persian Mekran.

Milvus lineatus (Gray.) The Black-eared Kite.

Though unrecorded in Baluchistan this kite must surely occur. Kites were unusually common during the Afghan War of 1879 and three obtained (Juv.) at Kandahar September 13, December 18, and February 23, by their size and new brown feathers on the crown I judge to be *lineatus*. W. 480, 495, 495. In British Museum.

Elanus cæruleus cæruleus (Desf.) The Black-winged Kite.

A straggler in N. Baluchistan of which there are three or four records, adult seen July 7, immature obtained April 7, adult seen August 16, and one obtained by Griffith in ' Afghanistan ' was perhaps in what is now Baluchistan.

St. John obtained it at Baghwana near Khozdar (S. Kalat) in August ; Blanford obtained it at Sonmeani on February 20, and Zugmayer at Las Belas on March 18. No records elsewhere ; status uncertain.

Circus macrourus (S. G., Gmel.) The Pallid Harrier.

A fairly common winter visitor to the lower plains and valleys but commoner as a passage migrant ; Barnes noted it as very common at Chaman in the wheat fields. It passes through in March to the end of April in the Quetta valley and at Kandahar. St. John records it on spring and autumn passage in Kalat. Murray thought that it bred on the Khojak—' building in May ' — but this requires verification.

On the Mekran coast Cumming records it at Ormarra in winter and spring and Blanford obtained it at Gwadar in December. Zugmayer got it in Las Belas in March and April ; it is probably not uncommon throughout the Mekran in winter and on passage.

Circus pygargus (L.) Montagu's Harrier.

Montagu's Harrier is probably a passage migrant in small numbers in the north. There is in the Quetta Museum one obtained at Baleli on April 19, 1914 (lab. *macrourus*) and there is one from Quetta in the British Museum ; St. John obtained one on the Khojak on September 9, 1881—perhaps the same bird.

Circus cyaneus (L.) The Hen Harrier.

The Hen Harrier is recorded as a fairly common winter visitor from mid-October to April and also on passage though I doubt if sight records can be trusted. I have seen several specimens obtained in the Quetta district in winter, and one from Kandahar.

There is no record in the Mekran but Hotson obtained it at Bampur in Persian Baluchistan in December, so it should occur.

Circus æruginosus (L.) The Marsh Harrier.

The Marsh Harrier is fairly common in suitable spots in N. Baluchistan and Kandahar from October to March.

It occurs here and there in the Mekran in winter.

Buteo ferox ferox (S. G., Gmel). The Long-legged Buzzard.

The status in the north is not clear. Radcliffe says it is resident and breeds in the Ziarat District ; Barnes believed that it bred in the Chaman District ;

Murray says she found it common at Gulistan in May and obtained on May 7, two young about two weeks out of the nest. On the other hand Meinertzhagen considered it to be absent from March to August though odd birds were seen in May and St. John says that it is not seen in Kalat in the summer. I know of no actual nest having been found. If it breeds at Ziarat all had gone from there in September. It is certainly found throughout the plains and lower valleys during the non-breeding months.

Throughout central and coastal Mekran and in Kalat it is a common winter visitor.

Accipiter badius cenchroides (Severtz.) The Shikra.

Duke and Meinertzhagen both record the Shikra from the Quetta valley in spring and autumn ; it is not a very common bird in the north where however it must breed here and there. Thus Cumming flushed a bird off the nest in Woodcock Spinney near Quetta on June 16, 1922, and St. John obtained it at Kandahar on June 9, where Swinhoe also got one on April 17.

So too it must breed in S. Kalat as Duke secured one at Khozdar on June 12. Throughout Central Mekran it is not uncommon at least in winter ; Hotson obtained four between September 1 and December 12 and Blanford one at Bahu Kalat on the frontier in February where he found it not uncommon. It is not certain whether it breeds in central Mekran. In coastal Mekran it no doubt occurs here and there ; Cumming noted it at Ormarra in March and September.

Birds from central Mekran, S. Kalat, Quetta, and Kandahar (8 sp.) all belong to the race *cenchroides* and not to the Indian form, as also one from Wana in S. Waziristan (N.W.F.P.).

Accipiter nisus nisosimilis (Tickell.) The Asiatic Sparrow Hawk.

This race of sparrow hawk which is so widely distributed through Asia is a common winter visitor to and double passage migrant through N. Baluchistan in October and April.

It is rather a scarce winter visitor to coastal Mekran and there are no records of it, though it must occur, in central Mekran.

Accipiter nisus melanoschistus (Hume.) The Indian Sparrow Hawk.

Radcliffe records that he thinks Sparrow Hawks breed in the juniper forest at Ziarat, where Meinertzhagen also found them in June. However, I think that it is not *nisosimilis* which is said to breed there as the latter suggests, but this Himalayan race. There are birds in the Quetta Museum from Ziarat in July, doubtless breeding birds, and resemble well birds I obtained there in September when it was very common. All these adults are very dark blue above and also very large in size and match quite well birds from the Himalayas. *Nisosimilis* from the plains of India are paler than the typical European race and a series measure W. ♂ 207–216, ♀ 240–258, and this is about the range of measurement of *melanoschistus* which is *darker* than the European bird.

It is interesting to find this Himalayan bird extending to N.E. Baluchistan together with others of the Himalayan fauna. Its chief prey I found to be *Emberiza stewarti*.

Laubmann records *A. n. pallens* from Pishin-Quetta and Loralai but remarks that they are not so grey as Japanese birds. *Pallens* seems a somewhat doubtful race and probably his birds are *nisosimilis*. A female too from Panjgur, central Mekran with a wing of 198 mm. obtained on July 8, is also recorded as *pallens*. If this is sexed correctly it can hardly be a sparrow hawk at all but a Shikra which too is much more likely to be at Panjgur in July.

Accipiter virgatus said to have been obtained by Murray, I do not credit, and two birds from Quetta recorded by St. John as *Accipiter brevipes* are in the British Museum and are in fact *Accipiter nisus nisosimilis*.

Falco peregrinus calidus (Lath.) The Siberian Peregrine Falcon.

Peregrines are recorded as occasional winter visitors from the end of October onwards wherever jheels exist in N. Baluchistan. It would seem to be scarce and possibly some records refer to *babylonicus*. There is one from Quetta in the British Museum.

Cumming has noted it at Ormarra in winter, otherwise there are no records in the Mekran.

Falco peregrinus babylonicus, Scl. The Red-capped Peregrine.

This is the common falcon of N. Baluchistan and is no doubt resident though I have no records of actual nests. Meinertzhagan obtained it at Ziarat in July and saw others in June where I too saw it in September. St. John considered it common in Kalat and at Kandahar. I saw it in the Quetta Valley on August 17 and there is one from there in the Quetta Museum obtained on May 24 and several in the British Museum from Kandahar, Quetta and Kalat. It occurs at Sibi in winter.

At Ziarat I watched for some time some very pretty play-acting by a Shahin which was stooping in turn at each successive magpie which crossed the valley to its roosting haunt.

I saw a shahin at the Habb River on November 14 and Cumming records it from Ormarra on October 21 ; probably a winter visitor throughout the Mekran as it is in Sind.

Meinertzhagen records that he obtained *F. peregrinator* at Kushdil Khan on October 26, but, as he no longer has the specimen, he informs me he is not sure that he is correct in his identification.

Falco cherrug milvipes (Hodg.) The Saker Falcon.

The 'Cherrug' is apparently a scarce winter visitor to N. Baluchistan. There are two specimens from Quetta in the Quetta Museum obtained in January and another from Kushdil Khan on May 17. Murray records it in May and September. No records elsewhere. All examined are of the above race. Blanford (F. B. I., iii, 422) states that St. John obtained one at Quetta ; the latter does not record it nor can I trace the specimen now.

Falco jugger (Gray.) The Laggar Falcon.

The status of this falcon in the north is not clear. Barnes records it as very rare at Chaman but says he saw a pair in April ; St. John regarded it as not uncommon and says he obtained it twice at Quetta ; Marshall too thought it fairly common in the cold weather and located a pair nesting in a cliff in April. Swinhoe records it from Chaman in May and Murray records it in this month at several places between the Bolan and Chaman. Of recent years however no one has met with it.

In S. Kalat it probably is not uncommon. Duke obtained it at Nal on May 2 and Hotson too at Chuttok near Nal on August 26 ; in central Mekran at Jebri in the Mashkai Valley on August 31, and west of Kolwa on April 8 ; so presumably in S. Kalat and central Mekran it is resident as it must be too in Las Belas. Cumming has noted it at Ormarra. Zarudny does not list it for Persian Baluchistan which is apparently beyond its limit of distribution.

Falco subbuteo subbuteo (L.) The Hobby.

I have examined a specimen in the Quetta Museum shot at Pishin-Quetta on October 1. Murray records it from Nushki and Meinertzhagen saw a pair at Ziarat on July 24. Rare ; status unknown.

Cumming records it as a winter visitor to Ormarra ; no other records.

Falco concolor (Temm.) The Sooty Falcon.

The addition of this falcon to the Baluchi avifauna is remarkable and unexpected. Labelled as *F. amurensis*, I found in the Quetta Museum an undoubted specimen of *F. concolor*—an adult male—; it was obtained by W. D. Cumming at Charbar on August 31, 1912 (not October 24, 1912, as labelled). Mr. Cumming tells me that he saw another about the same time in the hills near there ; he further tells me that on May 4, 1901, after a cyclone he took two falcons alive at Ormarra, which he thought at the time were, and of course may have been, *F. amurensis ;* however, they were not preserved.

This is the first record north of Arabia; one recorded from Muscat (*Ibis*, 1886, p. 163) is in such a bad condition that it is hard to say whether it has been correctly identified or not.

The Charbar bird measures W. 278, T. 133. Bill from cere 13. Ts. 33.5 Md. toe 32.5. It has since been sent to the British Museum where Mr. Kinnear kindly compared it with Madagascar specimens, and he finds that it is a very pale bird, but there are insufficient skins in England to define any races.

Falco æsalon insignis (Clark.) The Merlin.

Swinhoe records the Merlin as common in winter at Kandahar: Murray says it is common everywhere north of Quetta and probably breeds in the Khojak, but this requires confirmation. He however says that a bird he examined from Mundi Hissar was a young one with underwing coverts not fully grown. Not recorded of recent years, and no records elsewhere. I have examined two from Kandahar in January and February and two from Pishin-Quetta in December and all are referrable to the above race.

Falco chiquera chiquera (Daudin.) The Red-headed Merlin.

Nicoll Cumming records the Red-headed Merlin from the Sibi plain where it may well occur. Murray says he obtained it at Bibi Nani in the Bolan and also at Kili Abdulla in May but even if this is correct I cannot credit his statement that it is fairly common throughout the country, if by this he means hill Baluchistan. No one has since met with it. No records elsewhere.

Falco tinnunculus tinnunculus (L.) The Kestrel.

The Kestrel is common throughout N. Baluchistan and is resident as a species though very likely some are winter visitors and some summer visitors or passage migrants. It breeds plentifully in cliff faces, holes or ledges in perpendicular river banks at 5 to 10,000 feet and in old Magpie nests. Marshall records 4 fresh eggs on May 14, Betham a clutch of 5 on April 12, but at the lower elevation of Kandahar Swinhoe notes young by the beginning of April.

It breeds as far south at all events as S. Kalat; in central Mekran it is common enough at least in winter and Blanford met with at as late as March 31, and I see no reason why it should not breed there since according to Cumming it is common on the Mekran Coast range round Ormarra and breeds on the headland at the end of March or early in April. To the Las Belas and Sibi plains it is probably only as a winter visitor.

The question is what is the breeding race of Kestrel in Baluchistan? In the North I have only seen birds from Kandahar which at the end of March one may suppose are breeding birds and these are undoubtedly of the typical race ♂♂ W. 249, 250 T. 172; ♀ W. 253, T. 165. All winter birds from Quetta-Pishin and Kandahar in the north and from the Mekran I consider also to belong to the typical race but whether the Mekran breeding bird is also, remains to be proved. Hartert and Zarudny record *F. t. saturatus* as resident in Persian Baluchistan but none from British territory appear to be of this race 6 ♂♂ W. 236–250; T. 163–172; 5 ♀♀ W. 244–268, T. 164–185.

The largest and the smallest birds are precisely alike in colour.

Columba livia neglecta (Hume.) The Rock Pigeon.

'Kapoth' (Bal.). 'Kaftar', (Pers).

Throughout the whole of N. Baluchistan, except perhaps in the forest area, the Rock Dove is common in most places and especially in the valleys and cliffs while in winter it congregates into huge flocks. Besides cliffs, etc., it nests freely in the underground water channels (Karezes) which at intervals have shafts leading into them; eggs and young are recorded in May but probably as elsewhere the breeding season is a prolonged one but not extending to the winter months.

Throughout central and coastal Mekran it is likewise common and resident and one of the characteristic birds of a small resident avifauna; Hotson records eggs on August 21.

I have examined a fair number of these birds, eight from N. Baluchistan and three from the Mekran and I consider all belong to the race *neglectus* the type of which came from Ladak; in Ladak are found Rock Doves with white rumps, *livia* of older authors, alongside birds with blue-grey tinged rumps (*intermedia* of some authors); the same obtains in Kashmir, Gilgit, Punjab, Sind and in Baluchistan. In size their wings vary from 219 in females to 238 in males and Baluchistan birds have the same range of measurement and colour.

Laubmann records *intermedia* from Gwadar; I have seen no *intermedia* from Baluchistan or plains of N. W. India; it is the bird of the Indian Peninsula with dark slate rump and I should much doubt its occurrence, at Gwadar. Laubmann's specimens (four) are small W. 211–214 but perhaps

they are not in good feather. North of Gwadar, near Dizak in Persian Mekran, I have seen two typical *neglectus* with wings 231 and 235 and here too may be found whitish or greyish rumped birds ; in the extreme east in the Habb valley *neglectus* also breeds.

Columba palumbus casiotis (Bonap.) The Eastern Wood Pigeon.

The Wood Pigeon is fairly common in the juniper forests at 8,000 ft. at Ziarat and breeds there as it probably does on Harboi in Kalat ; Cumming records it from Zarghun in summer. A good many must leave the forest for the winter as very few were to be seen at Ziarat early in October ; St. John too says in the autumn it is found in the lower hills. Barnes records it at Chaman in winter, leaving for the hills in June. Radcliffe noted it in the Zhob Valley from March to May. It seems to be only a straggler to the Quetta Valley ; Murray recorded it from Kirta, Dozan in the Bolan and Sagee. Swinhoe met with it between the Khojak and Kandahar in April.

South of Kalat the only record is of one obtained at Turbat in Southern Central Mekran on November 27 by Hotson.

Columba eversmanni (Bonap.) The Eastern Stock Dove.

It is strange that this bird is unrecorded in British Baluchistan. One was obtained and another seen at Charbar on September 24, 1912 by W. D. Cumming and it has been obtained in April at Kandahar.

Streptopelia turtur arenicola (Hart.) The Persian Turtle Dove.

A straggler on passage in N. Baluchistan. Swinhoe obtained one at Quetta on May 7. Murray records it at Chaman on April 7 and on the Khojak on May 5.

Streptopelia senegalensis cambayensis (Gm.). The Little Brown Dove.

Chiefly a summer visitor to N. Baluchistan and widely distributed in cultivated parts up to 8,500 ft. ; here and there in the lower valleys some winter while in the Sibi plain it is doubtless resident, as it is at Kandahar breeding there at the end of February. Barnes says it is absent from Chaman from October to March, which probably represent the months of departure and arrival, and breeds in April. Throughout the Nuskhi district it is a characteristic bird. At Sheik Mandah near Quetta eggs are recorded on April 17 and a late brood of young on August 28.

In central and coastal Mekran and in Las Belas it is one of the commonest and one of the few well distributed species and is resident ; it is particularly common in the date groves and cultivation. It extends further west than the Perso-Baluch boundary and is common at Charbar, Bampur, said to occur at Bunder Abbas and has been recorded even in Iraq.

Eleven examined from Baluchistan and Kandahar ; there is no doubt that the breeding bird belongs to the race *cambayensis ;* their wings measure 125–131·5 as in a topo-typical series. Two from Kandahar in March may belong to the larger Turkestan race *ermanni ;* they measured 135 and 139 mm. but a female shot also at Kandahar on the same day is the smallest of any —125 mm.

Streptopelia decaocto decaocto (Fulv.) The Indian Ring Dove.

'Jungli-Kapoth.' (Bal.).

A summer visitor to N. Baluchistan arriving in the second week of March and leaving in October, the Indian Ring-Dove is very common ; eggs are recorded from end of April to end of June. It is not found above 6,000 ft. and only occasional birds are seen in winter. In Kandahar and Sibi plains however it is resident ; it is common enough in the Nushki district in April.

A common and characteristic bird of central and coastal Mekran and Las Belas and is resident ; its distribution extends a long way westward of course.

Streptopelia orientalis meena (Sykes.) The Indian Rufous Turtle Dove.

Meinertzhagen informs me that he obtained two on passage at Quetta on October 1 and June 3.

Œnopopelia tranquebarica tranquebarica (Herm.) The Red Turtle Dove.

Murray recorded this Dove from Sibi where it may well occur as a hot weather visitor ; it is quite likely to occur in Las Belas too.

Pterocles orientalis (L). The Imperial Sand Grouse.

The Imperial Sand Grouse is a resident and also a passage migrant in N. Baluchistan. During September and October enormous numbers pass through the Quetta District doubtless bound for the Punjab and N. Sind, etc., the return passage taking place in March and April. At lower elevations however it is common in winter ; Swinhoe records it as plentiful all the year in the plains west of the Khojak and Hotson found it in numbers coming to water at Nushki on December 15, when a bag of 67 was made ; it is common too in the Sibi plain at this season. It is *the* common winter Sandgrouse in the Zhob and Loralai districts from early September to mid-March.

Some breed round Quetta ; there is a half grown chick in the Quetta Museum obtained on September 12, and Capt. Hanna tells me he saw chicks there in July. Numbers breed at Chaman in May (Barnes) and eggs are recorded thence on June 29. Meinertzhagen has seen them in pairs at Kushdilkhan on July 29, where too W. D. Cumming saw numbers coming to drink on June 28. In the Zhob Valley it is recorded in April and May. Under Harböi Hotson met with it on July 2.

South of Kalat it must breed also ; Zugmayer obtained it on July 13, at Panjgur and Hotson found pairs in several places in this district at the end of April. It is the common Sand-Grouse of the Persian Highlands.

Pterocles lichtensteini lichtensteini (Temm.) The Close-barred Sand Grouse.

In North Baluchistan the status of this Sand Grouse is not clear ; D. Radcliffe believes that he saw it once. Tufnell records that two were shot and several seen on the Bhor Plain (locality ?) in 1879. Newnham records it from near Quetta. It must I think be rare and Kalat and N. E. Baluchistan mostly too high for it.

Throughout central and coastal Mekran however it is in places common and resident affecting as elsewhere rocky desert and scrub at the foot hills. Hotson met with it at Mand and at many places in the Panjgur and Kolwas Districts in April and July and records it as far north as Zayah in Kharan where it must breed (obtained June 27). Cumming has found it in rocky nullahs near Ormarra and it occurs on the Pabb Hills in Las Belas up to the Sind boundary. It extends to Persian Mekran on the one side and to Sind west of the Indus on the other.

I cannot recognize an Asiatic race of this Sand Grouse ; the markings are subject to great individual variation, some are coarsely barred, others more finely in both Asiatic and the typical bird and in both sexes also there is a yellowish and a greyish type in both ; in both the size is alike ; I have examined all the specimens in the British Museum and Tring Museum and my own collection—a large series in all.

Pterocles coronatus atratus (Hart.) The Coronetted Sand Grouse.

Barnes considered the Coronetted Sand Grouse to be less common than the Imperial in the neighbourhood of Chaman but a few breed there. He found two nests on April 30 and in May ; the nests were just depressions scratched out by the birds in the open plain. It appears nowhere to be common in the north ; it is recorded from the Zhob Valley in January and Lt. Searight met with two flocks there on October 4, 1924. There is a specimen in the Quetta Museum from Said Hamid obtained on December 23 ; Tufnell in 1881 recorded it from ' Vitakri years ago.' St. John on the other hand says this is the only small Sand Grouse in S. Afghanistan and generally distributed in small lots and that between Kandahar and the Helmund in July it was common. I have a recent record of it at Chaman in July and there is an egg in the British Museum taken there on May 27, 1908.

In central and coastal Mekran it is according to Hotson the commonest small Sand Grouse, moving about locally in the cold weather. Apart from winter records he met with it at Teghat W. of Khozdar in the valley of the Dhor on August 26th and saw several flocks at Harbud S. E. of Panjgur on April 27.

Barnes' eggs measured 38 × 26·75 and 41 × 27·3 ; shell fine with moderate gloss, creamy white with blotches and streaks of washed-out yellow-brown and

pale sepia. An egg in the Quetta Museum obtained (addled) at Panjgur by Mr. Wilson of the I. E. T. may be of this species also ; the ground colour is almost white and it has a few pale lilac grey spots all over ; it measures 42 × 29.

Pterocles alchatus caudacutus (Gmel.) The Large Pin-tailed Sand Grouse.

Barnes thought that this Sand Grouse was resident at Chaman though he never found its nest, but in suitable places throughout N. Baluchistan it is a common Spring and Autumn passage migrant in early March and in November ; Meinertzhagen gives Said Hamid as the best place in the Quetta District. St. John considered it not so generally distributed as the Imperial and a more strictly desert bird ; it must breed on and over the Afghan boundary as he noted it between Kandahar and the Helmund in July. To the Sibi plain it is probably a winter visitor as it is found in enormous flocks round Jacobabad at that time.

In Lower Baluchistan records are lacking save that Laubmann records one from Panjgur, Central Mekran, on July 13, 1911 so it apparently breeds there too.

Pterocles senegalensis erlangeri (Neum.) The Common Sand Grouse.

There is very little information concerning this Sand Grouse in N. Baluchistan Marshall says it passes through the Quetta District in September and October and D. Radcliffe also mentions it as a Spring and Autumn passage migrant ; it is doubtless found as a resident in the Sibi plain.

All along the Mekran coast and in Las Belas plain it is common and resident. Hotson obtained it on the Persian boundary at Mand otherwise I have no records of it in central Mekran, Jhalawan or S. Kalat ; it would appear to avoid the more hilly country.

Pterocles senegallus (L.) The Spotted Sand Grouse.

'Kuttu' (Bal.)

There are very few records of the Spotted Sand Grouse in the hill country of N. Baluchistan ; one in the Quetta Museum was obtained at Said Hamid on November 26. However at the entrance to the Bolan Pass and in the foot hills of the Sibi plain it is common enough and doubtless resident. In S. Kalat Hotson met with it at Surab in August. Throughout Coastal Mekran it is met with here and there and is resident moving about but locally. Hotson came across it in the valley of the Nihing in May ; it extends into Persian Baluchistan (Jask, Pahrah) and to Bampur but not to the Persian Highlands.

Ammoperdix griseogularis griseogularis (Brandt.) The See see.

The See see is common and resident in N. Baluchistan in all suitable country ; it avoids the open plains of course and is not found as high as the forest area but I have seen it at 7,000 ft. and it may be found at much lower elevations than the Chukar is. It especially delights in broken rocky ground at foot hills and the borders of cultivation in the smaller valleys. It occurs too all the way down the Bolan Pass to an elevation very little above that of the Sibi plain. It nests in mid April and May.

Throughout central and coastal Mekran it is common enough also, especially in the lower hills and stony ravines about the bases of the higher ranges. In the hills near the coast it may be found at quite low elevations. During the heat of the day Hotson found that these birds shelter in the Karez pits or openings to the underground water channels. In the south nests may be found by the middle of March.

I have examined a good series from Baluchistan. They vary very much in coloration but are not distinguishable from the typical race.

Alectoris græca koralkovi (Zar.) The Chukar.

'Kabak.' (Pers. Bal.)

In the North the Chukar is common throughout the hill country up to 11,000 ft. and in some places exceedingly abundant ; it is very resident hardly moving down at all in winter and so is not found in the lower valleys and plains. The home of the Chukar may be said to be the hillsides above 7,000 ft. where a few bushes, grasses, and other plants are dotted about on the boulder strewn slopes of the higher ranges ; from here they work their way down to some

stream in the hill valley to drink about 8 a.m. and also to feed in the adjoining cultivation. But in some seasons they are equally at home in the juniper forest (8-9,000 ft.) ; in 1919—a bad Chukar year—they were practically absent from the Ziarat forests. The breeding season begins in mid-April and 6 to 9 eggs are recorded but nests of 15-20 which are said to occur (Barnes) may be the product of two hens. Chukar may still be found, but not so commonly as of yore, on Gatacre and Kitchener Hills close to Quetta and they certainly breed there (6,000 ft.) The gathering together of coveys to drink at favourite places is made use of in Chukar shooting ; the birds must water every day and so if kept off their drinking places by beaters all the Chukar on the hillside may be found scattered about in coveys on the lower slopes near the stream. This does not sound a very sportsmanlike procedure but if a bag is to be made at all it is the only way ; the area is so vast and climbing and walking so difficult and exhausting that without some concentrating of the birds but few coveys would ever be found. In good years some exceptional bags have been made on the best grounds ; thus near Khawash Col. Ramsay informed me that he and two other guns shot over 700 in two mornings shoot. In 1919, a bad year, I shot with Col. Ramsay and the late Major Finnis on the same ground and our bag was only 54. Heavy spring rains are one cause of bad seasons and the other is a very dry winter and spring. Thus in 1902 the birds kept in packs all the summer and never bred as there was no grass seeds, etc. for the young ; the old birds subsisted by digging up roots and the hillsides were scored by burrows 4 to 6 inches deep in places which they had excavated out for this purpose.

Throughout the hills of Central Makran and in the Coastal Makran ranges as low as 3,000 ft. (in Persian Baluchistan as low as 1,600 ft.) this Partridge is common while in Las Belas it occurs in the Khirthar and its outliers, the Pabb and Khuda ranges.

I have examined the following specimens, Quetta District 6, Kalat 6, Panjgur 1 Khirthar (Sind) 3, Persian Makran 2 (topotypes) and all appear to me to be the same though there is some individual variation, and I assign them all to Zarudny's race *koriakovi*. Wings 148-164 mm. Birds from the Suleiman Range in the extreme N.E. I have not seen.

Francolinus francolinus bogdanowi (Zar.) The Black Partridge.

'Port.' (Bal.)

In the North the Black Partridge is found in cultivation and suitable jungle, in some places, up to 3,000 ft. It is common enough on the Sind frontier and at the other end of the plain in the Sibi District and is found in the Marri and Bugti country below 3,000 ft. In the Loralai District it apparently reaches up to 5,000 ft. and is found at Gumbaz, Mekhtar, Musa Khel, Toi Sar and eastward of this line according to Lt. Searight. I have no records from the Bolan but it occurs as far as Babar Kach in the Harnai Valley ; odd records of birds in the Quetta Valley are doubtless due to escapes. It occurs again in the Kandahar District.

In S. Kalat it occurs as far north at all events as Khozdar (3,000 ft.) and St. John says even to 4,000 ft. In central and coastal Mekran it is common in many of the valleys such as those of the Habb, Dhor, Mashkai, Hingol and Nihing Rivers.

The Sibi plain and Las Belas birds are almost certain to belong to the Sind race *henrici* but I have not examined any. I have examined twelve birds, those from W. Coastal Makran. (Dasht. R.) Central Makran (Maud, Nihing River, Buleda District, Kolwa District), are *bogdanowi ;* 3 birds from Hingol River S. Kalat and Jhalawan are rather intermediate between *henrici* and *bogdanowi*. Many of Zarudny's points of diagnosis of this race do not hold good but I think that *bogdanowi* is distinguishable through its paler coloring and paler neck ring from *henrici*. Wing 10 ♂♂ 153-164, 2 ♀♀ 156-160.

Francolinus pondicerianus mecranensis. (Zar.) The Grey Partridge.

The Grey Partridge is found in suitable spots round the Sibi plain and in the lower end of the Bolan to Kundilani : Col. Ramsay informs me that it occurs too in the lower hills of the Marri and Bugti country. Ball records it from the valleys of the Suleimans and Lt. Searight informs me it is very numerous on the Rakhni plain below Fort Munroe and is found in the Loralai District in the same localities as given for the Black Partridge.

Common in Las Belas it extends throughout coastal and central Mekran in suitable scrub jungle to Persian Baluchistan and on to Lars and Bunder Abbas in E. Persia. It occurs in S. Kalat and Hotson found it at Wad 4,000 ft. in Jhalawan and in the valley of the Mashkai at Pirander 2,000 ft., but it does not as a rule appear to ascend as high as the Black Partridge does.

Ten examined from Jhalawan and Mashkai Valley west to Persian Baluchistan and all belong to the paler greyer form described from the last locality. None seen from the Sibi district or Las Belas which may be *interpositus* or intermediate between the two races as are some from S. W. Sind.

Coturnix coturnix coturnix (L.) The Quail.

'Kurrak' (Bal.)

In the North the Quail is chiefly a passage migrant and in small numbers, a few however must breed as a nest with eggs is recorded by Meinertzhagen taken by a native near Quetta at the end of May; at Kandahar Swinhoe recorded that the Quail arrives at the end of March and St. John says it breeds there in April and May in the cultivation and in similar places elsewhere as perhaps at Fort Sandeman, where birds have been seen in May though it is chiefly a passage migrant there in April and September.

In Coastal Mekran it is a passage migrant in mid-August to the end of September, at times fairly plentiful while a few over winter. W. D. Cumming tells me that on August 20, 1901 a flight attracted by lights entered the offices of the telegraph station at Ormarra and many were also killed by the wire cable round the compound. In Central Mekran it has only been noted on passage.

Coturnix coromandelica (Gm.) The Rain Quail.

The Rain Quail is only recorded from the Habb Valley where Le Messurier saw old and young on September 1st. Probably some occur every good monsoon.

Marshall records in the *Quetta-Pishin Gazette* that another Quail, other than the common, is occasionally seen in the hills but none has been shot. On October 2, 1912 W. D. Cumming saw at Charbar a Quail of a species quite unknown to him.

Rallus aquaticus korejewi (Zar.) The Water Rail.

A straggler in winter to N. Baluchistan; only records:—one near Pishin January, 1899, Quetta two in November, one in December, one March 1.

Porzana parva (Scop.) The Little Crake.

St. John obtained the Little Crake in the autumn at Quetta. Swinhoe found it rather common near Kandahar and obtained specimens in February and March. There is in the British Museum one from the Bolan Pass where Murray records it as common. There is a specimen in the Quetta Museum from Quetta August 31. (lab. *pusilla*).

Porzana pusilla pusilla (Pall.) The Eastern Baillon's Crake.

Baillon's Crake is a passage migrant in N. Baluchistan in August and September, probably not uncommon. Barnes noted it as abundant at Chaman in September; St. John met with it at Quetta in the autumn. Two specimens obtained August 24 in different years are in the Quetta Museum. It has been obtained at Nushki in September and at Chagai on October 7.

Status in Lower Baluchistan unknown; probably a winter visitor as in Sind. One was obtained by Butler in Mekran, and one by Hotson on September 10 at Sib on the Persian side.

Porzana porzana (L.) The Spotted Crake.

Status probably similar to last. There are specimens in Quetta Museum October 1 and November 1. W. D. Cumming obtained it at Ormarra in Mekran on September 20. Zurudny's *Porzana p. maculipennis* described from Seistan appears to be an aberration.

Gallinula chloropus parvifrons (Blyth.) The Waterhen.

St. John obtained one at Kandahar in April; Barnes had several brought to him at Chaman in March; Murray got it there April 31.

In Lower Baluchistan, Blanford obtained it on the Persian side at Sibi March 26, and Hotson saw it at Harbud Central Mekran on April 27.

Mr. Ludlow has a clutch of 6 eggs from Sirunda jheel, Las Belas, taken on June 20, 1915 which certainly seem to be of this species.

Porphyrio poliocephalus poliocephalus (Lath.) The Purple Waterhen.

'Bistuni.' (Pers.)

Porphyrio poliocephalus seistanicus Sar and Harms. The Seistan Purple Waterhen.

It is possible that a few Purple Waterhens may be resident in the Quetta district; Marshall records seeing 7 or 8 in thick reeds in a small river near Quetta in August and thought that they bred there; Barnes records that it is a straggler at Chaman after rain (September 10). St. John says a few occur yearly in the autumn at Quetta. Swinhoe obtained it at Kandahar in March whence Murray also received specimens. In suitable jheels in the Sibi District it doubtless occurs. It is recorded from Nushki in January.

Further south, however, it is commoner. Hotson met with it numerously in August and September in the valley of the Mashkai and northwards to Kalat, as high as 5,190 ft. He met with it too in the valley of the Hingol at Korak (Kolwa) and Rekin (Arawan) on April 18. It is common also in Las Belas.

I have examined 4 Baluchi specimens; two females near Kalat measure W. 268 and 258, and must, if sexed correctly, be *seistanicus* and a Nushki male. W. 269 is probably also of this race.

One from the Hingol River however, is too small W. 242 and must be placed under the typical race as almost certainly too will be found to be the Las Belas and Sibi birds.

Fulica atra (L.) The Coot.

The Coot is a non-breeding visitant to N. Baluchistan, common enough on larger sheets of water (Kushdil Khan, Seranan, etc.) while odd ones occur in the small rivers also. At Kandahar and Chaman it has been noted on passage in February and March. Common in suitable spots in the Sibi district. Though no doubt, the majority are winter visitors quite a number remain throughout the summer; it has been noted on Khushdil by Meinertzhagen and W. D. Cumming in May, June and July, and it has been obtained at Sibi at the end of May. One which Cumming obtained at the end of June was flightless through moult.

In Mekran it doubtless occurs in suitable waters though there are few records; W. D. Cumming obtained it at Ormarra in November and December.

Megalornis grus. The Common Crane.

Cranes are recorded migrating north over the Quetta district. In the Mekran too Blanford saw them performing a similar migration. Hotson noted the first arrivals in S. Kelat on September 24 to 30. Probably here also a passage migrant; but there are so few records anywhere that the status is uncertain.

A. virgo probably also occurs, but there are no positive records.

Tetrax tetrax orientalis (Hart.) The Little Bustard.

Swinhoe obtained a Little Bustard at Kandahar; Murray records one from near there on November 13. Cumming obtained one at Ormarra in Mekran in 1904 and its wings are in the British Museum. Evidently a rare straggler anywhere.

Otis tarda has been obtained in S. Afghanistan at Bala on the Murghab R. but not so far in Baluchistan.

Chlamydotis undulata macqueeni (Gray.) The Houbara.

'Charz' and 'Charras.' (Bal). 'Thukder,' 'Thukderri.' (Pers.)

The Houbara occurs in N. Baluchistan mostly as a passage migrant, but here and there in the valleys and plains some may be met with in winter.

It has been found at the end of March and in April in large numbers especially on the plains between Pishin and the Kwaja Amran ; Meinertzhagen records that 60 were shot there in one day by 4 guns. It passes through again in the autumn, while to the Sibi Plain it is a winter visitor in suitable places, as also noted by Masson over eighty years ago.

Throughout the Mekran it is found in winter in fair numbers wherever there are sandy plains and scrub jungle, and it even frequents the sandhills of the coast, while cultivation such as rape, etc., or date groves are an attraction ; so too is water. Cumming tells me he has seen 12 or 15 of these birds at a time in the vicinity of shallow rain-pools in the sandhills waiting to come to drink (5.30 p.m.). When the water fails they will come in to drink at spills from wells But in the Mekran some, however, nest. Hotson obtained one at Nikin Daf, 53 miles out on the Panjgur-Kalat road on June 8, and had a half grown young one brought in alive on June 11 at Panjgur. Cumming too has met with a family party ; he tells me that once at Ormarra six were driven towards him, two adults and four small ones ; unsuspicious of his presence, the male ran on and went behind a bush and then faced round to the others, working his neck plumes to cover and uncover the white in front, waiting until the female ran up which then went through a similar performance whilst the male took charge. Cumming further informs me that his predecessor at Ormarra had Houbara chicks brought in.

Sypheotides indica (Gmel.) =*aurita* auct. The Florican.

The Florican occurs at least in the eastern part of Coastal Mekran in some years. Le Messurier records that on October 3, 15 were shot on the Baluchi side of the Habb R., and that one at least was only ' nearly fledged ' and all were in brown dress. Cumming once came across a couple at Ormarra and obtained one. Hotson too obtained one in the river bed of the Hingol R. at Gili on September 10. Probably it is a rain visitor as in Lower Sind.

Œdicnemus œdicnemus astutus (Hart.) The Stone Curlew.

' Kurwanak '.

In N. Baluchistan the Stone Curlew is probably not so rare as records indicate and its status is doubtful. Marshall obtained it in March, Meinertzhagen got a pair in the Popalzai Forest on April 9 ; W. D. Cumming tells me he has seen recent footprints of this bird at Sheik Mandah near Quetta on July 16. Lt. Searight informs me that he saw these at Loralai on March 13, 1925, and that one at Kuria Wasta on May 23, 1924, certainly had young. I have examined two in the Quetta Museum obtained at Saranan on October 12, and at Mithri near Sibi October 25, and both these belong to the race *astutus*, as does one in the British Museum from Gandaka (Sibi plain) ; in this last locality it is probably not uncommon and resident.

In Central Mekran it must be fairly common as it was well known to Mr. Wilson of the Indo-Persian Telegraphs at Panjgur, and the natives there had the above name for it. Throughout Coastal Mekran it is fairly common ; Cumming met with it fairly often at Ormarra and Charbar, and found a nest at the former place on April 16. The only Mekran bird I have seen comes from Gili in the Hingol valley ; this is a fresh moulted bird and is far more rufus than any *astutus* I have ever seen, and I cannot pick it out from a series of *saharæ* ! It is a male W. 236 B. 32. It may be noted I have recorded both these races from Iraq ; these Asiatic Stone Curlews want further study with more material.

Esacus recurvirostris (Cuv.) The Great Stone Plover.

The Great Stone Plover extends its range at least as far as Ormarra along the Mekran coast where W. D. Cumming has met with it. It breeds at Sonmeani whence I have seen eggs in Mr. Ludlow's collection taken in June. Swinhoe found a nest in the Habb R. near Minad Khan on May 24. It doubtless breeds in other suitable places.

Dromas ardeola Paykuki. The Crab Plover.

Bishop obtained three on the Mekran coast in January and Cumming shot one on the beach at Ormarra on September 4. Probably a rather uncommon winter visitor.

Cursorius coromandelicus (Gmel.) The Indian Courser.

The only record within our area relates to birds shot by Cumming at Roumii in the Pabb Hills, Las Belas. It should occur throughout Las Belas in suitable places as it is common in the plains on the Sind side of the Habb Valley.

Cursorius cursor cursor (Lath) = *gallicus*. The Cream-coloured Courser.

Brahui. 'Askalo'.

This courser would seem to be uncommon, judging by the records, in N. Beluchistan; Barnes says it was not often met with at Chaman; Marshall obtained it in September; W. D. Cumming has seen it near Quetta in September and October; St. John met with it at Pishin in August. Meinertzhagen came across a few pairs near Quetta in April and one in the Quetta Museum was obtained there in March. At Sibi it occurs and might well breed in the plain and the same applies to the Nushki plain where Hotson found it at Munchi Chah. T.P. on April 18.

In S. Kalat and Central Mekran it is evidently not uncommon as Hotson came across it there a good many times in August and September. Along the Mekran coast it occurs in suitable places and Cumming notes it as a winter visitor August to April at Ormarra but at Jask on the Persian side he had eggs brought him on March 1 which he considered were of this species.

I cannot differentiate an Indian race of this courser.

Glareola pratincola pratincola (L.) The Pratincole.

Swinhoe obtained one at Bibi Nani in the Bolan Pass on May 18, 1881 and St. John got another at Kandahar, April 23, 1879. Otherwise no other records in N. Baluchistan, though Cumming tells me he thought he saw it at Khusdilkhan June 27, 1923. It probably breeds at the Sirunda jheel in Las Belas, as a shikari, whom Mr. Ludlow sent there, and who knew the birds well in the Sind colonies, reported that he saw them there in May.

Hydrophasianus chirurgus (Scop.) The Pheasant-tailed Jacana.

One was seen near Quetta by Meinertzhagen, doubtless a straggler, on July 11. It should, however, occur in jheels near Sibi, as it is common in N. Sind.

Arenaria interpres interpres (L.) The Turnstone.

Not uncommon on the coast of the Mekran, associating with other surf-feeding waders. Latest date May 25. No records inland.

Lobivanellus indicus aigneri (Laub.) The Red-wattled Lapwing.

Falco ix, p. 30, 1913—Sonmeani in Las Belas.

The Red-wattled Lapwing is not very common in N. Baluchistan, but a few pairs are probably resident in the Quetta district. Both Meinertzhagen and myself have met with pairs on the Lora R. in August, and Cumming has seen them there in June and also at Khusdilkhan. Radcliffe saw a few at Ziarat in June and July. Barnes considered it uncommon at Chaman owing to lack of water but found a nest on May 10. Ball records it from the higher parts of the Suleimans 3-5,000 ft. in July where it must also breed. It is common and resident on the Anumbar River from Wahar to Gumbaz (Loralai District). There are scattered records from Quetta in winter. According to Swinhoe it is common at Kandahar and in the Bolan Pass, while at Sibi it is of course, plentiful, as it is in parts of Kalat.

As regards Central Mekran, information is lacking, but it is sure to occur. From the Habb R. through Las Belas and along the Mekran coast it is resident in suitable places and thence extends to Persian Baluchistan, Persia (Henjam, Bunder Abbas, Shiraz,) Muscat and to Iraq. I have already (*Ibis*, 1923, pp. 665–6) dealt fully with this race. Briefly it has less green and purple sheens than the typical race and averages very slightly larger.

Murray records the Yellow-wattled Lapwing *Sarciophorus malabaricus* from Soriab and Quetta as not uncommon in the last week of March; as by this date the first have only just reached Lower Sind, and as I have on records of this species from Upper Sind at all, it is extremely unlikely to be found at 5,000 ft. in the Quetta valley. It may, however, well occur in Las Belas.

Vanellus vanellus (L.) The Lapwing.

The Lapwing occurs in the Quetta Valley, Kandahar and in suitable spots in Kalat as a winter visitor, sometimes in large flocks; earliest record August 2. In Mekran, Hotson met with it at Turbat in the Nihing Valley on November 28, otherwise there are no records though it probably occurs in suitable places.

Chettusia gregaria (Pall.) The Sociable Lapwing.

Barnes noted the Sociable Lapwing as very uncommon at Chaman; Murray records it thence in April.

Chettusia leucura (Licht.) The White-tailed Lapwing.

The White-tailed Lapwing occurs in the Quetta Valley chiefly as a spring and autumn passage migrant, but it has also been obtained in December. To Kandahar, however, it is a common winter visitor, as it is in Kalat and probably to the Sibi plain in suitable spots; earliest record September 11. It should occur in winter in the watery parts of the Mekran and Las Belas, but the only records come from the Persian Mekran in March and November.

Squatarola squatarola squatarola (L.) The Grey Plover.

A not uncommon winter visitor to the coast of the Mekran. Mostly singly or in pairs as a rule.

Pluvialis apricarius (L.) The Golden Plover.

One was obtained by Blanford at Gwadar in December. Murray records that he saw *P. d. fulvus* near Sibi. It should occur, but I have no positive record; it has been obtained at Kalati-Ghilzai in S. Afghanistan and at Karachi. The European bird is but a vagrant.

Charadrius leschenaulti (Less.) Geoffroy's Sand Plover.
Charadrius mongolus atrifrons (Wagler.) The Mongolian Sand Plover.

Both these Sand-Plovers were obtained according to Mr. Finn on the 1896 Baluchi-Afghan Boundary Expedition; no locality given. The larger species has been obtained at Quetta in March, a flock of six were noted, doubtless on passage. Both species are common on the coast of the Mekran in winter.

Charadrius dubius curonicus (Gmel.) The Little Ringed Plover.
Charadrius dubius jerdoni (Legge). The Indian Little Ringed Plover.

The Little Ringed Plover is fairly common in suitable spots throughout N. Baluchistan; to the Quetta District it is a summer visitor arriving at the end of February or early March and leaves in August; it breeds freely round such waters as Khushdil Khan and on the gravelly stretches of the Lora R. Meinertzhagen thus records them and noted eggs in the first half of June. At lower altitudes, St. John indicates that it is a winter visitor, as he says that this and the Kentish Plover are common in cold weather 'beyond the passes'. Swinhoe too found it at that season at Kandahar whence it disappears in April.

Throughout Central and Coastal Makran and S. Kalat it certainly occurs not uncommonly, but all records and specimens relate to dates between August 25 and April 15 so it is uncertain whether it breeds or not. In Las Belas I believe it breeds, however. I shot a pair in the Habb R. on June 16, which had the appearance of having bred.

As regards the races which occur; three March birds from the Quetta District which I have examined are certainly *curonicus*, as are two April birds in Meinertzhagen's collection, and he tells me that he was in error in recording them as *jerdoni*; spring and autumn birds from S. Baluchistan also are all *curonicus*. The only *jerdoni* I have seen from Baluchistan are the above recorded birds from the Habb Valley.

Charadrius alexandrinus alexandrinus (L.) The Kentish Plover.

The status of the Kentish Plover in N. Baluchistan is much the same as that of the Little Ringed Plover; it arrives according to Meinertzhagen in the Quetta District early in April and leaves in September. It nests freely at Kushdil Khan on the dried muddy margins and islands of the Jheel; eggs were found by Meinertzhagen on May 18 and June 2, on the latter date a

clutch of four. Cumming found several nests with 1 to 3 eggs on June 26. To Kandahar it is a winter visitor.

In the rest of Baluchistan it is recorded from the Mekran Coast where it appears to be a common resident though the only note of an actual nest is from Jask on the Persian side (young 10 days old on May 24). In Las Belas I found a pair or two on June 16 in the Habb Valley which seemed to have finished breeding. It must occur here and there in Central Mekran but the only record is from Isfandak on the border where Blanford obtained one on March 8.

Hœmatopus ostralegus longipes (But.) The Oyster-catcher.

The only record in the north is Meinertzhagen's who has seen this bird at Kushdil on April 29 and May 17.

A winter visitor to the whole of the Mekran Coast in variable numbers.

Himantopus himantopus himantopus (L.) The Stilt.

To the very few suitable localities the Stilt is a summer visitor in variable numbers in the north. It breeds at Kushdil Khan where Meinertzhagen found nests in 1913 and 1914 and Cumming in 1923. It arrives early in March and leaves in August; at Kandahar it is common too in March but there is no information as to whether it breeds there Full cultches are recorded on June 10 and June 17 in different years. Many eggs get taken by natives and at times many are destroyed by sudden rising of the waters.

I have no record of the Stilt breeding on the Mekran Coast except in Las Belas; here at the great Sirunda Jheel at Sonmeani a good many nest on the dried margins. Ludlow has eggs taken there on May 20 and I have young in down thence taken July 13; here it is practically resident but in the rest of the Mekran it is a fairly common winter visitor.

Recurvirostra avocetta avocetta (L.) The Avocet.

Meinertzhagen records that a few pairs arrive at Khushdil early in March and that in 1913 one pair bred; after disturbing the nest the eggs were transported by the birds across the lake (600 yards) to the other side! None bred in 1914 and in 1923 Cumming saw a fairly large flock on June 26 which was very wild so presumably were not breeding. No doubt variations in local conditions determine whether any breed or not. Murray records it at Sibi in March otherwise there are no other records in the north.

To the Mekran Coast it is said to be a winter visitor in small numbers.

Limosa limosa limosa (L.) The Black-tailed Godwit.

It is peculiar there are so few records of this bird in N. Baluchistan; Marshall obtained one at Babar Kach in March. Murray records it in the Bolan Pass in March and April; at Kandahar Swinhoe found it numerous on passage in March. No one seems to have met with it in recent years but surely it must occur?

It is fairly common in Central and Coastal Mekran in suitable spots in September and October (earliest September 4) and probably it overwinters but records are lacking.

Limosa lapponica lapponica (L.) The Bar-tailed Godwit.

There is specimen from Baluchistan in the British Museum; doubtless from the Mekran Coast where it should be numerous in winter.

Numenius arquata lineatus Cuv. The Curlew.

The Curlew does not seem to halt much on passage in N. Baluchistan as Meinertzhagen considered it uncommon, he met with it only on April 9, August 12 and September 30. Capt. Hanna informs me he heard many passing over Chaman on the night of July 31, 1919. There is one in the Quetta Museum from Saranan on April 9.

There are no records from the rest of Baluchistan save from the Mekran coast where it is fairly common in the mangrove swamps in winter.

Numenius phæopus phæopus (L.) The Whimbrel.

I can find no record of the Whimbrel in the north where it surely must sometimes occur on passage. Some winter on the Mekran Coast but it

probably is commoner on passage there. W. D. Cumming informed me that both Whimbrel and Curlew on the Mekran sometimes come inland and feed in the sandhills. Hotson obtained one at Sibi on the Persian Mekran on September 9.

Phalaropus lobatus (L.) The Red-necked Phalarope.

The Red-necked Phalarope must occur annually on autumn passage in N. Baluchistan. Barnes met with it in September and St. John on October 19 at Chaman ; there is a specimen from Kushdil in the Quetta Museum obtained on September 10 and Cumming picked up a dead bird near Quetta on September 23 ; at Sibi I have seen it on October 8. On spring passage it is recorded on March 6 and 28, April 30 and on May 5.

As in Sind so in S. Kalat, Jhalawan, and Central Mekran it is not uncommon on autumn passage, Hotson meeting with several small lots at various places between September 2 and October 4. Having reached their winter quarters few linger on land on the Mekran coast but Cumming once saw a pair in a rain water pool at Ormarra. At sea off the Mekran coast it is an excessively abundant winter visitor though its distribution is patchy ; one may steam for hours and never see one and then come across flock after flock each containing 100 or more individuals and they are always very wild allowing no boat to come within 200 yards as a rule. Sometimes they come as near the land as Ormarra May but they are more often met with 4 to 10 miles and even to 30 miles from the coastline, as soon however as very deep water (over 200 fathoms) is reached not one is to be seen. Butler records them from this coast as late as May 20 but as in Sind few or none appear to halt on spring passage inland in Mekran. Numerous off the coast by mid-November Hume's notes under *Phalaropus fulicarius* (S.F. vol. i) and Blanford's (Eastern Persia, vol. ii, p. 284) all refer in reality to the above species.

Limicola falcinella falcinella (Pont.) The Broad-billed Sandpiper.

Occurs throughout the Mekran Coast in winter where it is probably quite common. Hotson obtained it on passage on the Rhotak River on August 3 but there are no other records away from the coast, but it is likely to occur on passage.

Terekia cinerea (Gulden.) The Terek Sandpiper.

Recorded from Sonmeani and Ormarra on the Mekran in winter ; probably common along the whole coast line. No records elsewhere.

Erolia minuta minuta (Leisl.) The Little Stint.

' Tanki ', Baluch for small waders.

A double passage migrant in N. Baluchistan, passing in numbers in April (latest date May 28) and again in September and October ; a few are said to over-winter. In Central Mekran the only records refer to September and April so it is probably a passage migrant ; on the Mekran Coast it winters in numbers having arrived there by mid-September.

Erolia temminckii (Leisl.) Temminck's Stint.

There are curiously few records of this very common Indian bird but this is probably due to its being overlooked. Hotson obtained it on the Nihing River in winter and Blanford and myself met with it in the Habb Valley in October and November.

Erolia alpina alpina (L.) The Dunlin.

In N. Baluchistan it has only been noted at Khushdil Khan and Quetta on passage on November 30 and in third week of May ; it may be commoner on passage than records indicate. Very common on the Mekran Coasts in winter but unrecorded elsewhere.

Erolia ferruginea (Brün.) The Curlew Sandpiper.

Meinertzhagen found it common at Khushdil Khan on May 16 to 20 ; Murray records it from Quetta on March 22. It occurs in winter on the Mekran Coast.

Erolia canutus canutus (L.) The Knot.

Meinertzhagen obtained a solitary bird at Khushdil on March 26 the only record for Baluchistan and India.

Erolia tenuirostris (Horsf.) The Great Knot.

The Great Knot was seen by Hume near Gwadar in winter ; this is the only record but it probably occurs in other places on the Mekran Coast although it is unknown anywhere west of Gwadar.

Calidris alba (Pall.) The Sanderling.

Only recorded from the actual coast line of Mekran where it is abundant in winter. The Sanderling must be capable of immense flights, it has never been found on passage on land in India.

Machetes pugnax (L.) The Ruff.

A spring and autumn passage migrant in N. Baluchistan, not uncommon in suitable spots. Marshall obtained one in February but most pass through the Quetta Valley in March and the same applies to Kandahar. Odd birds are recorded from Khushdil Khan in December ; it has been noted on passage again in October. Both in Central and Coastal Mekran it has been obtained in September and in winter.

Totanus totanus eurhinus (Oberh.) The Redshank.

In N. Baluchistan the common Redshank does not appear to be very common. Meinertzhagen only noted it twice—small flocks at Khushdil on October 26 and May 19. St. John considered it common in winter till mid-April but this very likely referred to the Kandahar plain whence Swinhoe recorded it as common in winter. W D. Cumming saw non-breeding birds at Khushdil on June 26.

To Coastal Mekran it is a not uncommon winter visitor, earliest noted on August 20, and it occurs in Central Mekran also in winter. Meinertzhagen must have made a slip in recording as *T. erythropus* a bird he shot at Khushdil on October 26 ; this bird is in the Quetta Museum and is undoubtedly a common Redshank ; specimens of *erythropus* in the Quetta Museum recorded by D. Radcliffe were in fact obtained in Sind. However this bird should occur in Baluchistan and Murray lists it without comment.

Totanus stagnatilis (Bech.) The Marsh Sandpiper.

There is one in the Quetta Museum obtained on August 15, at Saranan. W. D. Cumming informed me that it occurs at Ormarra in winter. These are the only records and like the Greenshank it is probably overlooked or badly recorded.

Totanus nebularius (Gunn.) The Greenshank.

St. John records the Greenshank as not uncommon in Kalat and S. Afghanistan in winter and Swinhoe considered it a winter visitor to Kandahar. In the Quetta District it appears to be uncommon as there is only one record—a bird obtained at Bostan on November 9. In Coastal Mekran Cumming noted it at Ormarra in winter and I have seen it in the Habb Valley ; it probably occurs here and there throughout the Mekran.

Tringa hypolencus (L.) The Common Sandpiper.

During spring and autumn passage the common Sandpiper is common on the streams and waters of N. Baluchistan ; the birds pass through from early April to the end of May returning again in August. Delmé Radcliffe thought it possible that odd pairs breed at Khushdil but no further evidence has been obtained of this. Meinertzhagen however has brought forward strong circumstantial evidence that a pair bred on the Arak stream at 9,000 ft. in 1914. It would not be surprising to find that here and there at that elevation a pair or two do nest in the forest area.

To the Sibi plain and the rest of Baluchistan it is a winter visitor in fair numbers.

Tringa ochropus (L.) The Green Sandpiper.

The Green Sandpiper is probably the most generally distributed and least rare of all the waders in N. Baluchistan since it can adapt itself to the merest puddle or trickle ; moreover besides being a bird of both passages it is also a winter visitor. Odd birds also may be seen throughout the summer months as obtains in

many parts of N.W. India, though none of course breeds. It has been recorded at 8,000 ft. but is equally at home in winter in the Sibi plain.

Throughout Kalat, Central and Coastal Mekran it is a common winter visitor wherever there is any water and here too some over-summer.

Tringa glareola (L.) The Wood Sandpiper.

In N. Baluchistan the Wood Sandpiper is a common passage migrant in April and May, rather less common on autumn passage in August ; odd ones are recorded in winter. In Kalat St. John remarked that it is common in summer but he probably meant in May and August.

In Central Mekran it must be common enough at least on passage but records are very few and relate to March, April and September.

Scolopax rusticola rusticola (L.) The Woodcock.

A few occur every year in N. Baluchistan from 5–8,000 ft. Newnham records 20–30 were shot in the winter of 1888 and that the main arrivals came early in December, earliest November 11. Swinhoe states that 5 were obtained in one day. Meinertzhagen gives October and February as the extreme dates. No records elsewhere.

Capella solitaria (Hodg.) The Solitary Snipe.

An annual visitor to N. Baluchistan in October, earliest September 29, but more appear to come in some years more than others. In Quetta it has been found in gardens in the cantonment, suitable places being few, while at Ziarat one for several days haunted a piece of swampy grass a few feet square caused by a leak in a water pipe. Some must over winter as Duke obtained one at Kalat in December and I have heard of one shot in January somewhere between Quetta and Fort Sandeman while another was obtained near Loralai on March 13, 1925.

Capella gallinago gallinago (L.) The Common Snipe.

A common passage migrant in N. Baluchistan while a few over-winter in suitable places. Meinertzhagen gives mid-August as the earliest date, most arriving in September and passing through again in March and a few till the end of April : 83 couple is the largest bag for one day. To the Sibi plain, Central and Coastal Mekran it is a winter visitor arriving at the end of August (24 and 28 in two years), corresponding pretty well with the first arrivals in Lower Sind. A creamy white specimen obtained at Sibi on March 22 is in the Quetta Museum. I have no record of the Pin-tailed Snipe in Baluchistan (*C. stenura*) but odd ones are almost certain to occur.

Limnocryptes minima (Brünn.) The Jack Snipe.

Occurs throughout Baluchistan in suitable places arriving in mid-October (Quetta and Mekran ; as also in Sind) ; it is particularly common on spring passage in the north according to Meinertzhagen who has seen a 100 in a day. At Kandahar Swinhoe noted it as a weather migrant at the end of December. I know of no certain record of the Painted Snipe though Murray lists it without comment.

Larus fuscus taimyrensis (But.) The Lesser Black-backed Gull.

Larus argentatus cachinnans (Pall.) The Yellow-legged Herring Gull.

Both these Gulls are very common along the Mekran Coast in winter from early November at all events up to March 24 and probably later. They act as scavengers at all the coastal villages.

Meinertzhagen records a flock of *cachinnans* at Khushdil Khan on April 17 otherwise there is no record in N. Baluchistan for either species but they doubtless do halt on passage on suitable waters.

Larus ichthyaetus, (Pall.) The Great Black-headed Gull.

One shot at Saranan on March 29 is the sole record of this bird in the North. It is fairly common along the Mekran coast in winter ; Hume obtained one on February 17, which had already attained breeding dress.

Larus brunneicephalus Jerd. The Brown-headed Gull.

Marshall records a large flock at Khushdil in March : in the Makran W. D. Cumming has noted it as a winter visitor as far west as Charbar, so it probably occurs here and there along the whole coast.

Larus ridibundus ridibundus (L.) The Black-headed Gull.

A common winter visitor throughout Baluchistan wherever suitable spot exist. Meinertzhagen says it arrives in the Quetta Valley by mid-October, most leave in April but some remain till the end of May. He says that he has never seen any near Quetta in breeding dress, which is curious since many assume the brown head before leaving Sind.

It is of course especially common throughout the Makran Coast where it arrives by mid-October.

Larus genei (Breme.) The Slender-billed Gull.

' Kothar ' Bal.

The Slender-billed Gull is one of the commonest gulls on the Makran Coast and it is a constant resident though very likely their numbers are augmented in winter. Large flocks may be seen fishing a mile or so out at sea on surface swimming fry. Considerable numbers breed at least in some years on the large island in the Sirunda jheel at Sonmeani, Las Belas. Mr. Ludlow has eggs taken there on May 15 but most are not laid till the first week in June. I have both eggs and young in down obtained there on July 16. The nests are quite considerable structures and Caspian and Gull-billed Terns breed in the colony with them. In some years when the jheel is very full few or perhaps none breed there. It doubtless breeds in several other places in Makran. On May 28, 1878, Mr. Nash of the I. E. T. found a small colony in a swamp at the head of a creek about 8 miles N. N. W. of Ormarra called Moorputti. The nests contained 1 to 3 fresh eggs on that date. The nests were solid pads of seaweed about 8 inches in diameter.

There are no records elsewhere in Baluchistan of this bird.

Larus hemprichii (Brüch.) Hemprich's Gull.

This is probably the commonest Gull on the Makran Coast and is resident. It is a tame confiding bird and may often be seen round boats scavenging fish offal, but unlike the larger gulls does not frequent the villages for this purpose. Early in June these gulls begin to draw in along the Sind coast to the breeding grounds and they congregate in thousands to breed on the island of Astolah, 24 miles S. W. of Pasni. Butler who landed there on May 29, found the plateau of the island already covered from end to end with gulls which were absurdly tame but breeding had not commenced ; scrapes in the sand were plentiful but these may have been for dusting purposes (?) He subsequently sent on August 6 a boat to the island and the natives obtained many fresh eggs for him. The nests were said to be large affairs composed of twigs built in bushes and well concealed ! This is a good example of the inability of the native to describe accurately anything he has seen ; as a matter of fact the nests are a slight depression with a few bents of grass and *salsola* scrub situated at the *side* of and *sheltered* by a tuft of salsola, according to Sir Percy Cox who visited the island on July 17, 1907. The maximum number of eggs appears to be 3.

Chlidonias leucopareia indica (Stev.) The Whiskered Tern.

Meinertzhagen records that several were seen on Khushdil Khan in May 1914 there is one in the British Museum from Quetta May 22. Evidently a passage migrant, as it also is in Central Makran ; Hotson found it on the Rohtak R. near the Persian boundary on September 24, and in the Hingol valley on the 19th. W. D. Cumming observed it at Charbar on August 6.

Hydroprogne caspia caspia (Pall.) The Caspian Tern.

' Kothar ' (in Makran.)

The Caspian Tern visits such waters as Khushdil Khan and Saranan on passage. Meinertzhagen has noted them from April 30 to May 17, and a pair till June 20. No evidence of breeding.

On the Makran coast it is common and resident. It breeds with the Gull-billed Terns and Slender-billed gulls on a large island in Sirundha jheel in Las Belas ; laying had just begun on May 15, many eggs were obtained on June 14, and by July 16, most were hatched and some young were nearly ready to fly. A great many eggs I believe are addled by the heat, and the mortality in young too appears to be great. The legs and feet of newly hatched chicks are yellowish-flesh colored.

Geochelidon nilotica nilotica (Gm.) The Gull-billed Tern.

'Kothar' (in Makran.)

No record in N. Baluchistan.

Common and resident on the Makran Coast ; a very large colony breeds in the Sirunda jheel (see above). Mr. Ludlow had many eggs brought him thence on June 16, and I had a few eggs and young up to half grown birds on July 13. Both adults and young had fed on locusts.

Sterna sandvicensis sandvicensis (Lath.) The Sandwich Tern.

The Sandwich Tern is a winter visitor to the Makran Coast in fair numbers. Barnes was informed that it bred there. However this suggestion is not as yet confirmed, nor is it ever likely to be. Unrecorded elsewhere.

Sterna bengalensis bengalensis Less. The Lesser Crested Tern.

The Lesser Crested Tern is common all along the Makran Coast in winter and at all events up to the end of May. Birds shot at the latter date are in full breeding dress. It is however not known to breed in the Makran Coast as yet.

Sterna bergii velox Cretz. The Greater Crested Tern.

The Greater Crested Tern is common and resident on the Makran Coast breeding in large numbers on the island of Astolah off Pasni. Butler who landed there on May 29, 1877 found that this Tern had just commenced to lay. The colony consisted of four large groups nesting together on the bare ground on the most exposed part of the island ; each nest was about one foot apart from the next and he actually found 47 eggs in a space of 8 feet square. As many as 7,000 fresh eggs have been gathered there by natives early in June.

As is well known the eggs of this tern vary so much that hardly two are alike. As in other Tern colonies elsewhere the eggs are liable to be pillaged by Gulls—in this case by Hemprich's Gulls.

From an examination of a large series of this Tern from the Makran Coast, I am of opinion that *S. bergii bakeri* described thence is not a good race and is indistinguishable from *velox*.

Sterna melanogaster Temm. The Black-bellied Tern.

Barnes records that this Tern is not uncommon in the Bolan Pass and he obtained a straggler at Chaman on June 3. St. John obtained another at Quetta in the autumn 1881. Murray lists the Indian River Tern (*S. seena*) but I have no definite record.

Sterna repressa Hart. (= *albigena* auct). The White-cheeked Tern.

Butler met with the White-cheeked Tern in flocks commonly along the Makran Coast in the latter half of May and he remarks that it is one of the commonest terns at that time. Zarudny records it at Charbar on March 16. I think that it is probable that this tern is only a passage migrant on the Makran Coast, to and from its breeding grounds in the Persian Gulf, though there seems to be no reason why it should not breed there.

Sterna hirundo hirundo (L.) The Common Tern.

Meinertzhagen has recorded this tern as plentiful in May and early June on Khushdil Khan.

It must be a passage migrant in Lower Baluchistan but the only record refers to a bird obtained by Hotson at Sib on the Persian side on September 10. Like the Sind birds the Baluchi ones appear to belong to the typical race.

Sterna albifrons. The Little Tern.

Little Terns are only recorded from the Mekran Coast ; Butler mentions seeing this species at Jask in May. W. D. Cumming informed me that

saundersi may be found throughout the year at Ormarra and he has noted it at Charbar in November but as no specimens were obtained it is not certain. I saw two or three on the Habb River on June 16 but failed to get a specimen. A little tern is very common on the Sirunda jheel in Las Bela nesting in a different part to that occupied by the Caspian Terns, etc.; Mr. Ludlow had eggs brought him thence on May 28, 1915 which Mr. Stuart Baker identified as *saundersi* and on June 16, 1916 he received further eggs and a parent bird, the latter was identified by Mr. Baker as *albifrons* so that it still seems quite doubtful which race breeds on the Mekran and there are no specimens in the British Museum. One from Muscat belongs to the typical race. Major Cheesman obtained *saundersi* from Bahrein Island in April, from Handramaut Coast on May 8 in which month I have seen birds from Port Sudan.

Sterna anætheta fuligula (Licht.) The Red Sea Sooty Tern.

Butler noted this Tern as common on the Coast at Gwadar in the last half of May; Mr. W. D. Cumming has seen it in small flights at intervals during the winter and probably it is only common on passage to its breeding haunts in the Persian Gulf. It frequently roosts on ships passing up to the Gulf.

Anous stolidus pileatus (Scop.) The Phillipine Noddy Tern.

Butler noted a few between Pasni and Jask two or three miles from land at the end of May. W. D. Cumming caught five alive at Ormarra after a cyclone on May 4, 1901; they had taken shelter in some tamarisks.

Evidently a wanderer to the Mekran Coast and its status is not known; it does not breed so far as is known in the Persian Gulf. One of Butler's specimens in the British Museum is of this race.

Murray in his vague way said *Rhynchops albicollis* occurred on the coast; I know of no record; it may however be found as Zarudny records it from Rud-i-Sarbas in Persian Baluchistan.

Stercorarius parasiticus (L.) Richardson's Skua.

Richardson's Skua is not very uncommon along the Mekran Coast where Hume met with it at sea off Ormarra, Pasni, Gwader, etc., from the middle to end of February. Butler too saw about a dozen between Pasni and Gwader as late as May 13–17. Hume obtained one and made it the type of his *S. asiaticus*; it is in the British Museum where I have examined it; it is a young light-barred bird moulting body, wings and tail (February 16) to the light adult phase. I did not see this bird for certain along this coast in March and November. Curiously enough the oldest record of a Baluchi bird must refer to this species and perhaps is the earliest record of the Skua's habits. Early in the year 1604 a Portuguese mariner, one Pedro Texeira, of the coast off Oman 'saw certain 'birds chasing others from natural enmity. The weaker soar upward to escape 'from the stronger and in terror void the contents of their stomachs. The bird 'below hunting the others to this end or from natural spite as fast as this 'happens, opens his beak, catches the same droppings and eats them. I have 'it from natives that on this matter he subsists.'

Pelecanus onocrocotalus onocrocotalus (L.) The White Pelican.

The White Pelican is said to be resident in suitable places such as Khushdil Khan and Saranan in N. Baluchistan by which presumably is meant that birds may be seen there at any time of year; actual records relate however to the months December, February, April (latest 29). I have examined two in the Quetta Museum; one is certainly *onocrocotalus*, the other is smaller (W. 635 mm.) but it is a mounted bird and certainly the wing would measure more if straightened out; it is said to have 22 tail feathers but Pelicans' tails seldom have the full number of feathers; this bird probably is a small female *onocrocotalus*. This species is unrecorded in Mekran where it surely must occur.

Pelecanus crispus (Brüch.) The Dalmatian Pelican.

'Mesh-murg'.

Common in the bays and inlets on the Mekran Coast in winter: it has also been obtained at Sonmeani in Las Belas.

Phalacrocorax carbo sinensis (Shaw and Nodder). The Eastern Cormorant.

'Suh-murgh'.

Some Cormorants are always to be met with at Khushdil Khan and Saranan from November to July but apparently they do not breed there. This species is an abundant winter visitor to the Mekran Coast, and is also found in suitable rivers in Central Mekran such as the Mashkai, Nihing, etc. and on the Sirunda Jheel in Las Belas. Latest date April 26.

Phalacrocorax javanicus (Horsf.) The Indian Little Cormorant.

The Indian Cormorant was obtained in the Valley of the Mashkai by Hotson on September 3. It probably occurs commonly in suitable spots in the eastern part at all events of the Mekran, as may also *P. fuscicollis* which is common in the Karachi mangrove swamps.

Anhinga melanogaster (Penn.) The Indian Darter.

Murray records a pair from Pir Chowki at the entrance to the Bolan Pass on March 10 : it may well occur in the Sibi Jheel.

Sula dactylatra melanops (Hartl.) (= *cyanops* auct). The Masked Booby

Hume recorded this Gannet from Gwadar in February and Butler too met with it in May at intervals along the Mekran Coast. He noted that it fed on flying fish and was often in company with *Phaëton indicus.* A young bird which hit the telegraph wires at Charbar on July 31 is in the Quetta Museum so W. D. Cumming informed me. This bird is not known to breed on the Mekran Coast but I think it may possibly nest on one of the Kurya Muria Islands off the Arabian Coasts ; one of these islands (Haski) is covered with guano. Two obtained by Butler on May 14 are in the British Museum. It breeds according to von Henglin on Burda Rebschi, Somali Coast.

Phaëton ætherius indicus (Hume.) The Indian Tropic Bird.

Hume found this Tropic Bird commonly off Ormarra in February and Butler met with it from there to Gwadar in May. I too saw it between Pasni and Gwadar fairly often and again off Ormarra Head in March ; Cumming has noted it there in September. Sir Percy Cox has seen it off Astola in July. Though not yet proved to breed on the Mekran Coast I think it most likely does so on Ormarra Head ; it breeds in the Persian Gulf in March.

Oceanites oceanicus oceanicus (Kuhl.) Wilson's Petrel

Butler saw several of these small Petrels along the Mekran Coast between May 13 and 29 and obtained one ; it was nowhere common but more were seen between Pasni and Charbar than elsewhere. Zarudny too saw it at Charbar on March 12. Cumming has met with it at Ormarra, mostly storm driven birds on various dates between July 7 and September 23. It is of course a non-breeding visitor from the southern hemisphere.

Puffinus persicus (Hume.) The Persian Shearwater.

Hume found the Persian Shearwater at Korebutt on February 15 and obtained it between Gwadar and Muscat on February 21 (the type). Butler noted it commonly along the Makran Coast to Henjam in the Straits of Oman on May 13–20 and remarked on its shyness. I did not actually see this bird off the Baluchi Coast but found it very abundant in the Straits of Oman on March 22. Numbers were seen sitting on the water and in one place we passed a flock of quite 200 but they never allowed the steamer to approach within 200 yards. The type specimen in the British Museum is in full moult wings, etc. ; the breeding quarters are still unknown but must be on islets in the eastern part of the Persian Gulf or on the Arabian Coast.

Birds suggestive of a species of *Prion* have been recorded from the Makran but so far as no specimens have been obtained.

Puffinus tenuirostris tenuirostris (Temm.) The Slender-billed Shearwater.

In the *Bombay Nat. His. Soc. Journal*, xii, p. 767, W. D. Cumming records a Shearwater as *P. chlororhynchus* which had been brought to him at Ormarra, May 1899 ; it had been shot by Mr. Walter Scott of the P. G. Telegraph. Cumming tells me that strong S. W. winds were blowing at the time and

the weather generally had been unsettled for two or three days. This Shearwater is now in the British Museum where I and Mr. Kinnear have examined it and it is undoubtedly *P. tenuirostris* and not *chlororhynchus*.

Its breeding ground is unknown. Ridgeway records it from the N. Pacific and cites a specimen from Kotzebue Sound. In the British Museum there are specimens from Japan in May, Behring Island in June, and Bonin Island in May. It has not been recorded from Indian seas before. On March 14 I saw off the Mekran Coast a Shearwater in the distance which was not *P. persicus*.

Threskiornis melanocephalus melanocephalus (Lath.) The White Ibis.

Mr. Ludlow's shikari found a colony of the White Ibis in tamarisks at the Sirunda Jheel in Las Belas and brought back a breeding bird and eggs on July 8, 1915. There is no other information regarding this bird in Baluchistan. Murray lists the Black Ibis for Baluchistan but I know of no certain record.

Plegadis falcinellus falcinellus (L.) The Glossy Ibis.

The Glossy Ibis is not uncommon in suitable spots in the Quetta district on spring passage; D. Radcliffe says it occasionally occurs in winter. Large flocks visit Khushdil Khan and Saranan in April and May and Meinertzhagen records non-breeders there on July 12 and W. D. Cumming in another year saw them there on June 28. There is one in the British Museum from Pishin on August 27. No records from the rest of Baluchistan where it must occur in suitable spots.

Platalea leucorodia major (Temm and Schleg.) The Spoonbill.

The Spoonbill visits Khushdil Khan on passage; Meinertzhagen records a flock of 100 there on October 26, a few in November and again on May 17. Cumming saw a flock there on June 28 doubtless non-breeders. A specimen from Nushki in the Quetta Museum was obtained on November 9. Murray records a single bird from Pir Chowki in the Bolan on March 10.

On the Mekran Coast Cumming has noted it at Charbar in winter but at the Sirunda Jheel in Las Belas a few apparently breed in some years as Mr. Ludlow's shikari brought in an egg which was said to be and certainly seems to be that of a Spoonbill on July 8, 1915; the nest was in a large tamarisk standing in the Jheel.

Ciconia ciconia (L.) The White Stork.

The White Stork does not appear to be common. St. John noted it as occasional at Pishin and Kandahar in spring and autumn. There is one specimen in the Quetta Museum from Kahan shot on September 12.

It must occur occasionally at all events in lower Baluchistan. Hotson met with it at Magas on the Persian boundary on December 5, where Zarudny has also noted it. Zeugmayer obtained one at Panjgur on August 20. Meinertzhagen records the Kahan bird as *asiatica;* I have not examined it but Zeugmayer's bird, a female, measures W. 520, B. 154 (Laubmann) and so it must belong to the typical race. *Asiatica* does not seem to be at all a well-marked race.

Ciconia nigra (L.) The Black Stork.

Occasional odd birds occur in the Quetta district in winter; Meinertzhagen has seen such in October—November and at the end of April. There are specimens in the Quetta Museum from Saranan, November 16, Bolan River, March 18, and Quetta, January 10.

There are only two records from the rest of Baluchistan; a bird was shot by Cumming on the Vindar R. Mekran coast on November 19 and one was seen by Hotson near Pasni on February 23.

[Zarudny records *Dissoura episcopa* (one obtained and three seen) in Persian Baluchistan but I have no record in British territory. Murray lists the Painted Stork and the Open-bill for Baluchistan. Both might wander to Las Belas and Sibi plains but I have no definite record.]

Ardea purpurea manillensis (Meyen.) The Eastern Purple Heron.

Ardea purpurea purpurea (L.) The European Purple Heron.

Purple Herons do not seem to be common in Baluchistan. There is one in the Quetta Museum from Sibi, March 26, which I have examined and belongs

to the eastern race *manillensis* ; Meinertzhagen refers to two birds from Quetta and Nushki as belonging to the typical form *A. purpurea purpurea*.

Purple Herons are not uncommon at Ormarra in winter according to Cumming ; they should occur elsewhere in Lower Baluchistan but there are no records and no specimens.

Ardea cinerea cinerea (L.) The Common Heron.

The Grey Heron is not uncommon as a winter visitor in N. Baluchistan and is commoner as a passage migrant in October and again in March and April. Some however spend the summer as Cumming has seen it at Khushdil Khan on June 28 ; there is no evidence of its breeding there. Meinertzhagen has seen this Heron at times far from water searching for lizards and toads.

So far as is known it is a winter visitor to the whole of the Mekran area on suitable streams and pools and is numerous on the coast ; it is said to breed at Kalmat but this is only native information.

Egretta alba (L.) The Large Egret.

The Large White Egret is not very common at Khushdil Khan in winter ; it is recorded thence in February, March and November by Marshall and Meinertzhagen. It occurs occasionally at Kandahar.

Odd birds may be seen from time to time on the Mekran Coast in winter and probably elsewhere. No specimens examined.

Egretta garzetta garzetta (L.) The Little Egret.

Murray records the Little Egret from N. Baluchistan, probably from Sibi district.

Blanford says it occurs occasionally on the Makran coast and Cumming too has noted it at Ormarra.

Bubulcus ibis coromandus (Bodd.) The Cattle Egret.

Noted by Murray at Pir Chowki in the Bolan and at Sibi. St. John records that he got a *bubulcus* at Quetta in May 1887.

Demiegretta sacra asha (Sykes.) The Indian Reef Heron.

The Reef Heron is common along the Mekran Coast and is doubtless resident. Blanford noted the blue phase only ; I have seen both white and blue phases in the Habb River which they ascend to at least fifteen miles from the mouth.

Ardeola grayii (Sykes.) The Indian Pond Heron.

Outside the plains it is only recorded at Chaman where Barnes saw several on July 15, after rain ; in the Sibi plain however it is common and doubtless resident.

In the south Cumming has seen it at Ormarra in winter and I have found it in the Habb Valley in November ; it is probably resident in Las Belas.

Nycticorax nycticorax nycticorax (L.) The Night Heron.

'Machi Giratch' (Bal.)

The Night Heron occurs occasionally in the Quetta Valley ; there are specimens thence in the Quetta Museum obtained in March, April and September. It certainly occurs in winter at Sibi and is possibly resident in that district as Murray records that a small colony were building in Pistachio trees at Bibi Nani in the Bolan on May 21, where hill streams formed a small marsh. St. John recorded that there was a colony in a garden near Kandahar.

It occurs here and there in suitable spots throughout Coastal and Central Mekran but its status is not clear but it is known well enough to have a native name.

Ixobrychus minutus minutus (L.) The Little Bittern.

So far as is known the Little Bittern is a passage migrant in small numbers in the Quetta District, records and specimens relating to August and September April and May. Meinertzhagen however obtained one at Khushdil Khan on July 11, and St. John recorded it as not uncommon at Kandahar in summer.

Cumming informed me that one hit the telegraph wires at Ormarra on October 11, and that he has sometimes heard them passing over at night,

Blanford found it in spring at several places on the Persian side of the boundary.

[**Ixobrychus sinensis** (Gmel.) The Yellow Bittern.

Mr. J. W. N. Cumming records that he obtained a Yellow Bittern at Quetta in March 1907 ; both I and Meinertzhagen have failed to find this specimen in the Quetta Museum and so possibly there has been some mistake.]

Botaurus stellaris stellaris (L.) The Common Bittern.

In suitable spots especially near Khushdil Khan the Bittern is a common winter visitor ; Meinertzhagen records that fifteen were flushed in one day when snipe shooting there ; he further states that he has good reason to believe that a pair bred there in 1914, as on June 19, he heard a bird booming and the next morning flushed an adult and a young one just able to fly.

From Lower Baluchistan there is only one record—from Las Belas in March but suitable spots are doubtless few.

Phœnicopterus ruber antiquorum (Temm.) The Flamingo.

The Flamingo visits N. Baluchistan chiefly on passage ; thus Marshall records a large flock at Khushdil Khan in March ; Meinertzhagen in early May and at Saranan in April, while it has been noted at Abigum, Harnai and Nari Bank. A flock which settled on Khushdil Khan were so exhausted that six were captured alive. Cumming has seen a flock there on June 28, but there is no evidence that it breeds anywhere in the north.

It is very common at the Sirunda Jheel in Las Belas and all along the Mekran Coast but I could never hear of anything which suggested that they breed on Sirunda. The status is not clear ; W. D. Cumming was informed by the telegraph officer at Ormarra that in one year some bred near there, probably at Kalmat and this was confirmed by the natives ; it appears however that the swamp there is not always in a suitable state.

Phœnicopterus minor (Geoffr.) The Lesser Flamingo.

W. D. Cumming informs me that he saw one at Ormarra on September 16, 1903. A rare straggler as elsewhere.

Cygnus minor (Keyser and Bl.). (= *jankowskii*, But). Alpheraky's Swan.

A female was shot by Aitken on Khushdil Khan on December 17, 1913 and is in the Quetta Museum.

The evidence at present seems to show that this swan is a separate species and distinct from Bewick's Swan. W. D. Cumming in 1914 took measurements of this specimen and made a coloured drawing of the head and sent them to the British Museum from which this specimen was identified as above by Ogilvie-Grant. Cumming's measurements :—W. 19 in., B from frontal feathers $3\frac{3}{4}$ in., from gape $3\frac{1}{4}$ in. Black narrow edging on bill bordering the frontal feather.

Cygnus olor (Gm.) The Mute Swan.

Mute Swans visit N. Baluchistan from time to time. In 1900 when there was quite an invasion of these in N.W. India eight were seen and four shot at Bostan and others were seen on Kushdil about this time where single birds were noted by Meinertzhagen in February 1911, and November 1913.

On January 10, 1900, nine were seen on the Habb River in Las Belas and two obtained by Mr. Jones, I.E.T. ; at Jask in Persian Mekran two were shot by Mr. Griffith on February 11, 1911.

Anser anser (L.) The Grey Lag Goose.

The Grey-lag is a regular winter visitant to the waters of Khushdil and Saranan arriving at the end of October and the bulk leaving in April ; not very seldom however some may spend the summer there ; thus Meinertzhagen records six in the summer of 1913 and Cumming saw some there on June 28, 1923. Mr. A. Gordon informs me that geese always halt at the small tanks at Jhatpat in the Sibi plain at the migrating season, these being the last waters before the hills are reached. Geese were particularly abundant at Saranan in the winter of 1918–1919 in which year water in Sind was reduced to a minimum by failure of the monsoon.

It visits the Mekran Coast in winter but not in any numbers except perhaps at Sirunda.

Anser albifrons (Scop.) The White-fronted Goose.

Recorded by Murray from Sagee.

Dendrocygna javanica (Horsf.) The Lesser Whistling Teal.

There are no records of Lesser Whistling Teal in Baluchistan but it must occur at least in Las Belas. A shikari whom I sent to the Sirunda Jheel at Sonmeani brought back an egg, one of a nest of seven, which he took there on July 13, 1918. The nest was situated in thick reeds. The egg is nearly pure white and measures 47 × 35·5 mm. My identification has kindly been confirmed by Mr. Stuart Baker.

Tadorna tadorna (L.) The Common Shelduck.

The Shelduck is not common but it occurs in winter at Khushdil Khan and once as late, according to Meinertzhagen, as May 19, other records come from Said Hamid, Fort Sandeman, and Nushki.

The only record from S. Baluchistan comes from Turbat in the Nihing Valley where Hotson got one and saw others in the last week of November.

Casarca ferruginea (Pall.) The Ruddy Shelduck.

A few visit Khushdil and other waters on passage more especially in February and March. To Kandahar and Nushki Districts it is a not very uncommon winter visitor.

No records from Mekran.

Anas platyrhyncha platyrhyncha (L.) The Mallard.

The Mallard is common in suitable places arriving in early September and leaving at the end of March. Three pairs remained in Khushdil during the summer of 1914 and a flock was there on June 28, 1923; such over-summering non-breeders probably led Capt. *Roosmalcocq* to believe that they bred there; I know at all events of no actual proof of breeding beyond the latter's bare statement in the *Proceedings* of the Quetta N. Hist. Soc.

It must occur throughout the Mekran in favoured spots in winter but I only have records from the coast.

Anas pœcilorhyncha pœcilorhyncha (Forst.) The Spotbill.

Recorded from Baluchistan by Murray without comment; the Sibi plain is the only likely place.

Anas strepera (L.) The Gadwall.

The Gadwall is a common winter visitor from late September 15 to early April, a few lingering on till mid-May.

It occurs in suitable spots throughout Central-Coastal Mekran.

Anas penelope (L.) The Wigeon.

Common in winter from late September to April; a pair at Khushdil were seen by Meinertzhagen on June 20.

It occurs here and there throughout the Mekran; earliest October 3.

Anas acuta, L. The Pintail.

The Pintail in the north is chiefly a passage migrant, most passing through in October and November and not recorded after April but at lower elevations as at Nushki, Kandahar and Sibi a good many winter. It is found here and there throughout the Mekran, earliest September 10.

Anas angustirostris, Ménét The Marbled Duck

'Mow' (Bal.)

To North Baluchistan Meinertzhagen considers the Marbled Duck to be a winter visitor in small numbers and a summer visitor at irregular intervals. Aitken saw a pair in June 1913, frequenting a small island in Khushdil and saw others apparently not paired; later on he found an old bird with 14 ducklings. Meinertzhagen saw 6 pairs in June and July 1914 but could get no evidence of nesting.

At Ormarra Cumming tells me that he has met with this bird and it is said to have bred occasionally there in the rain water tanks ; Butler obtained what were evidently eggs of this duck from Moorpatti, north of Ormarra, taken by a native on June 19, 1878 ; the nest was under a babool bush in a large salt marsh.

Ludlow records that he received eggs of this duck with the parent bird taken by his shikari on June 14, 1915 at Sirunda Jheel, Las Belas ; according to his shikari it breeds freely there and the eggs are gathered for eating. The nests were in thick tussocky grass, well concealed and with a tunnel through the grass leading to the nest. Two nests contained 9 fresh and 14 incubated eggs. I too received eggs and an adult thence on July 16, 1919.

Querquedula crecca crecca (L.) The Common Teal.

The Teal is common everywhere in suitable places and is the best distributed of all the ducks. The first few arrive in the last week of August, most come early in September and they have left by the end of April, latest record May 9. It forms 30 to 50 per cent of most ' bags '. Webb-Ware records that between Nok Kundi and Tratoh near Munshi Chah Telegraph Post, he picked up 3 ducks and a Teal with broken wings apparently injured against the telegraph wires and the natives informed him that such birds were often found at this spot at the migratory season.

In winter it is found throughout the whole Mekran, earliest August 31.

Querquedula querquedula (L.) The Garganey Teal.

A few Garganey visit the waters of N. Baluchistan mostly on passage but it is never very common ; it is recorded as late as May 15.

Small numbers visit the Mekran on passage, earliest September 1, last October 23, and again in spring. Some were still on the Sirunda Jheel in the middle of May one year but had gone in June.

Spatula clypeata (L.) The Shoveler.

The Shoveler is common as a winter visitor in the north but more so as a passage migrant ; latest date May 19 and three stragglers were seen on the Zhob River on June 1, 1924.

It occurs on the Mekran Coast as a winter visitor and is very common on the Sirunda Jheel where some were still present in the middle of May.

Netta rufina (Pall.) The Red-crested Pochard.

Though Meinertzhagen records the Red-crested Pochard as an uncommon winter visitor from October to March others have considered it not so rare. St. John regarded it as commoner than the common Pochard as did Radcliffe, and Marshall found it to be one of the commonest ducks in Khushdil at the end of February. Cumming saw some there on June 28, 1923. Probably its status varies in different years according to the state of the jheels, a circumstance I have already noted in the Sind jheels.

It occurs in the Mekran Coast but suitable spots are very few except the Sirunda jheel.

Nyroca ferina ferina (L.) The Common Pochard.

The common Pochard is very common on the few open waters of the north ; it arrives at the end of September and leaves at the end of April. On Khushdil it is perhaps the commonest duck and Marshall records that at the end of February it composed a third of the bag of 110. Some appear to annually over-summer there without breeding as with other ducks ; Meinertzhagen has noted hundreds in May and June and a few in July ; Cumming too saw a flock there at the end of June.

It occurs on the Mekran Coast, no doubt commonly on Sirunda Jheel.

Nyroca nyroca nyroca (Güldenst) The White-eyed Pochard.

A not uncommon winter visitant ; Swinhoe regarded it as the next commonest duck to the Gadwall and says that he flushed many pairs from reeds and tamarisk on water courses from Pishin down to Kirta in the Bolan during May and thought that they might breed there. This however wants confirmation, though it would not be very surprising.

Not recorded in Mekran but sure to occur.

Nyroca fuligula (L.) The Tufted Pochard.

A fairly common winter visitor from late September to April. Meinertzhagen records it as early as August 14 and as late as May 17, Swinhoe also noted it in May and says it was very common at Kandahar and from Pishin to the Bolan in that month,—doubtless still on passage.

It is recorded from the Makran Coast.

Of ducks generally it may be said that the numbers are greatest in October and November and in March and April as the winter birds are reinforced by passage migrants to and from the plains ; also opinions will vary as to the commonness or otherwise of any particular species according to where and when the sportsman looks for it and to a less extent perhaps from year to year. The chief duck haunts are Khushdil Khan and Saranan in the Quetta District, Zangi Nanar in the Nushki District and Sirunda Jheel in Las Belas.

Glaucion clangula (L.) The Golden Eye.

A few Golden-eyes annually visit Khushdil from December to March and they are also recorded at Saranan and Zangi Nanar. Not recorded in Mekran.

Oxyura leucocephala (Scop.) The Stiff-tail.

The Stiff-tailed Duck is not very common but is more often met with than the golden-eye and when it occurs quite a flock may be met with ; most records relate to the months of November to February but Meinertzhagen records it also in April. Though met with from time to time on Khushdil and Saranan it seems to be a fairly constant winter visitor to Zangi Nanar in the Nushki District whence there are numerous specimens in the Quetta Museum. On waters where they occur they are very local keeping all the time to one particular spot. Further west in Seistan it is common.

Not recorded in Mekran.

Mergus albellus (L.) The Smew.

Fairly common winter visitor in the north, more abundant in some years than in others. Recorded as late as May 19 by Meinertzhagen and May 24, by Murray.

Not recorded in Makran.

Mergus serrator (L.) The Merganser.

One was obtained at Khushdil on April 3, 1902.

A not uncommon winter visitor in small flocks to the Mekran coast keeping much to the bays ; it is recorded from Ormarra, Charbar and Jask in December and January. Birds recorded as *Mergus merganser* by Bishop. (S. F. iv, 496) as occurring every winter on the Mekran coast undoubtedly refer to this species.

Podiceps cristatus cristatus (L.) The Great Crested Grebe.

Though D. Radcliffe records the Great Crested Grebe as a winter visitor to Khushdil Khan it undoubtedly in some years at all events breeds there. In 1913 three nests were found on August 12, by Mr. Aitken one containing 5 eggs ; the following year a pair were there in June and July but breeding was not established. Nesting doubtless depends on the state of the water. It no doubt occurs in winter also and there is a specimen in the Quetta Museum obtained there in March.

In winter this Grebe is common on the Mekran coast becoming quite maritime in habit ; it is generally to be met with in small parties keeping fairly close to the shore and especially to the bays. The earliest date is September 3 and the latest April 23. It is always very wary and wild. W. D. Cumming informed me that when feeding close in these birds sometimes get washed ashore by the breakers. Gwadar and Pasni Bays are particularly affected by them.

Podiceps ruficollis capensis (Salvad.) The Little Grebe.

'Birir' (Brahui).

The Little Grebe is common on all the larger sheets of water in the North ; on Khushdil Khan a great many breed. Meinertzhagen records 150 breeding there in 1913 while on June 6, 1914, he found over 100 nests, mostly with 3 eggs several with 4, one with 6 and one with 7. The nests were all floating structures composed of weed foliage, none exceeding 12 inches across the top. On June 8, 1923, W. D. Cumming found a good many nests there containing 1 to 6 eggs.

Elsewhere there are no breeding records ; it occurs on the Mekran coast in winter and Hotson met with it in August and September in S. Kalat and in the Mashkai R. and again at Harbud in Central Makran on April 26.

Podiceps nigricollis nigricollis (Brehm.) The Black-necked Grebe.

The Black-necked Grebe was unknown in N. Baluchistan till 1914 when Meinertzhagen discovered five pairs in the first week of May ; on June 20, in that year he saw hundreds of pairs and examined over 70 nests all situated in about an acre of water 2 feet deep. The nests contained mostly 3 eggs but two had 5 eggs each. The nests, made of weed stalk, were 15 to 18 inches across and attached firmly to the bottom of the jheel, consequently when the water rose after rain a week later all the nests were flooded and the Grebes deserted the locality. The Little Grebes whose nests were floating all survived the flood. I cannot hear that the Black-necked have attempted to breed at Khushdil again since.

On the Mekran coast it is a winter visitor and not uncommon especially in the bays such as Sonmeani and Gwadar.

Colymbus stellatus (Pont.) (=*septentrionalis* auct.). The Red-throated Diver.

There is only one record of the Red-throated Diver in Baluchistan and it has not as yet been recorded in India proper. On November 17, 1901, a bird was brought to W. D. Cumming at Ormarra by a native who had knocked it on the head as it came up close to his ' toney ' ; it was said that several were seen and that a few visit the coast occasionally. The bird is now in the British Museum.

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[Founded on a journey by Murray from Sibi to Chaman and back, March 7 to end of May 1880, and notes and specimens supplied to him by Barnes from Chaman, Dupuis at Quetta, Hutchings from Nushki, Quetta, etc., and Babington Peile and E. Watson. A considerable list but not always reliable.]

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THE POTTER WASP (*RHYNCHIUM NITIDULUM*)

BY

MAJOR R. W. G. HINGSTON, I.M.S.

(*With two plates and three text-figures*)

PART I

If we examine the ceilings of our rooms we are likely to discover a cluster of pots, four or five perhaps in number, all neatly glued together so as to lie parallel side by side. Each little pot is like a small bird's egg, and all are fixed by their bases to the ceiling from which the cluster projects. It is obvious that these cells are built of mud, but they have not that appearance of well-kneaded pottery which we saw in the work of the Mason Wasp (*Eumenes conica*).[1] This is a rough and granulated structure. Its surface is smeared with viscid mucilage: it is studded all over with irregular nodules of a brown sticky gum.

These pots are the work of a delightful little species, the Potter Wasp *Rhynchium nitidulum* of Smith (see Plate I).

Like *Eumenes conica*, she is remarkably fearless, entering boldly through open doors, hovering confidingly about the room in search of some secluded corner for her nest. Her character is well suited to observation and experiment. Being highly domesticated, she sticks close to her nest. She is so fearless as to remain on her cell while I cut pieces out of its wall. Her patience is untiring. She will face difficulty after difficulty in order to achieve the purpose in hand. Her industry is infinite. The work she toils at is particularly tedious, and she sticks to it the livelong day. Lastly and the point of special importance, this wasp shows wonderful intelligence. Experiment discloses a rational behaviour, so clear, so incontrovertible, that it forces me to modify established views on the capacity of the insect mind.

In this paper I will describe her plan of architecture. The next will be devoted to a series of experiments to illustrate the rational working of her mind.

First a word on her general appearance. She is scarcely larger than a honey-bee, and dressed in unassuming garb. Her jaws are not unlike those of *Eumenes*, a pair of narrow triangular blades that cross in the middle line. Her head is wedge-shaped with black shining eyes. From between these spring stout antennæ. Above them is the punctured vertex studded with tiny pits. Behind comes the thorax, free from fur, decorated in front with a pattern of points and prolonged behind into a pair of spines. Her abdomen is pale and silky. Her wings, which are folded along their length, glisten with a purplish sheen. Though dark, she is patched with silver.

[1] *Journ. B. N. S.*, vol. xxxi, Nos. 2, 3, 4.

In a velvet pile it grows above her jaws ; it forms a white collar round the front of the thorax, and clothes her abdomen in a satiny gloss.

Architecture

Now for her cell, a delicate piece of work. As a rule she fixes her nest to wood. I have seen her build on a plastered wall. This, however, is very unusual. For some reason she has a preference for wood. Thus she often selects a rafter, or perhaps the lintel of an open door, or the under surface of a wooden shelf. She seems to like some structure overhead, for she often builds on a wall or ceiling close beneath the shelter of a beam.

We naturally seek for some explanation as to why she should prefer wood. Her nest will adhere to other materials. Like *Eumenes* she might have chosen metal or glass. The explanation I give is this. Her preference is a relic of an old instinct. Bungalows are recent innovations. There must have been a time when this little architect had to build in more natural sites. In the jungle these sites will be the underside of branches or the hollows in the trunks of trees. No doubt it was there that she originally nested, and wood was the material on which she built. Now she has invaded human habitations. But this trace of the old instinct still remains. She will not have the walls and plaster ; only the beams of wood.

Now let us watch her building operations. I find a nest with two finished cells. The wasp is about to commence a third. In she comes with steady flight. The sound of her approach precedes her, for like *Eumenes* she comes humming through the air. She alights on her nest. Before her are two cells like a pair of eggs side by side. A cleft marks the line at which the cells join, and at the base of that cleft the wasp makes a ridge of mud. This is the first step in construction, the foundation-stone of her third cell. As soon as it is complete she rests for a moment, then, facing her architecture, backs away in flight.

The foundation of the cell is laid and methodical coming and going begins. Now we must watch her with minute care, for every architect in the insect world can teach us something new. Back she comes to continue work. A pellet of mud is in her jaws. Alighting on the nest, she clings to it perpendicularly. Her attitude is inverted, tip of abdomen directed upward, head thrust down upon the rising wall. Quickly and industriously she moulds her pellet. Her tarsi give it lateral support, her antennæ feel the ground before it, her mandibles, one on either side, guide it along the edge of the wall. How well does she perform this difficult operation of rolling a sphere along a knife edge. By her action the globule is lengthened out ; a film of mud is left behind, and this the wasp, with a jaw on either side, deftly moulds into the lamina of the wall. (See Plate II). One other little point. It may seem only a trivial detail, but later I will give it geometrical importance. The wasp, every time she adds a layer, always commences at the middle of the wall and rolls her pellet to one or other end. For instance, she first places it at the centre, then rolls it to the left end. Then she lifts

it back to the centre and rolls it to the right end of the wall. Then another lift to the centre and a roll to the left. Then again to the centre and a roll to the right. And so on until the pellet is used up.

Each pellet, of course, adds to the height of the wall; and the wasp, as she swings from side to side, shapes her edifice into a curve. She wastes no time in this delicate work. In one or two minutes the pellet is exhausted. Then she is off. In a minute or two she is back with another pellet which she moulds in a similar way.

Her pellets are composed of the most delicate material, slightly viscid nodules of clay. Only the very finest particles will suit. These she scrapes together, moistens with saliva, kneads into a mortar of pasty consistency, without a particle of grit. Such pellets, when spread out, rapidly harden. The wall is so delicate, only a mere shell, that each addition begins to set before the next is ready to be laid. This is an essential mode of workmanship when raising a rampart of mud. It reminded me of Arab architecture. The Arabs build exclusively with mud. They first raise a wall about a foot in height. This they allow to harden in the sun before adding a second layer. They continue to superimpose layer upon layer, but always allowing one to harden before attempting to apply the next. So it is with *Rhynchium* in her building operations. She likewise raises layer upon layer. While she gathers mortar for the next layer, the previous one becomes firm and dry. Thus the Arab and the wasp are comparable architects. Both work on similar principles, the only possible principles when raising an edifice of mud.

Now the cell is half built in the manner described. Though only a shell, it is fairly firm. In places its surface is marked with lines, faint indications of successive layers. Now, unexpectedly, a change occurs. The mason's manner of workmanship alters. For some reason she begins to build on a different plan. If we have watched with care we may have noticed that on the last few visits the wasp has behaved in an unaccustomed way. Instead of immediately commencing to build, she first pushes herself into the cell. She probes it down to the very bottom. What is her purpose? At first I am quite unable to understand it. It seems so insignificant. Perhaps it means nothing at all. But there is a reason. A change in method is about to take place, and the mason, when she pushes her head into the cell, is determining the exact moment for the change. For when she pushes in her head she can easily estimate the depth of the cell, or, in other words, the height to which she has built the wall. But at last there arrives a visit when she can push herself into the cell just down to the base of her wings. Apparently this is the depth required: this is the time for the change to take place. For at the next visit, after pushing herself in she does not as before come out immediately. She seats herself inside, abdomen at the bottom, head and thorax above the edge of the wall, and, in this strange attitude, begins to apply her clay. Now let us watch with special care. There is always some good reason for every little fact we see. She is squatting in her half built cell. A jaw

and an antennæ are on either side of the wall; her front tarsi are on the edge. She begins to mould. But now she no longer commences at the centre and rolls her pellet to one or other end. Her routine is different. She now commences at one end of the wall, rolls the pellet along to the other end, then rolls it the whole way back again. This is a new mode of workmanship, and she sticks to it till the cell is complete.

I fear that these details are a little complicated. Later we shall see that they have some importance. The point is that there are two phases in construction. First, the mason, hanging head downward, rolls her pellet from the centre to the ends. Then she reverses, sits upright in the cell and rolls from end to end.

I watch her at this work for about three hours. Layer is being superimposed on layer to form a graceful cell. At length it is finished. Her twenty-second visit brings the last pellet. The wall is raised to a sufficient height.

This last visit is of special importance. Her previous ones occupied a minute or two. This last one is a prolonged business for she has to inspect the whole of her work. The exterior is examined: she pushes herself inside, turns about, sits erect in the cell with only the tips of her antennæ outside. She often adds a finishing touch. The inside especially receives attention. A pellet may be cut into the smallest pieces which she uses to plaster small irregularities until the surface is smooth. Then she ceases, satisfied that the work is well finished and sound. A rest is earned after all this toil, so she sits for a little while inside the cell.

For ten minutes she remains idle. Her wall is raised to the full height; it would seem that her work was nearing an end. But such is far from being the case. The structure is a long way from being finished. There are certain urgent and important duties which she must attend to without delay. Her architecture needs thickening and strengthening. The wall is built of the finest clay, plastered smooth, exquisitely thin, a model of the mason's art. But it lacks the most essential quality, it is not yet sufficiently strong to protect the larva that will shelter inside. Parasites exist that could penetrate this chamber, thrusting their ovipositors through the masonry in order to lodge their eggs inside. Grace and delicacy will avail nothing in the absence of security and strength. Hence the very urgent need to thicken this wall of clay.

A short rest, therefore, is all she can afford. Then to work once more. She goes off, but does not, as before, return in a minute. I do not see her for half an hour. Something of special importance must engage her. Otherwise she would not delay so long. At length she returns. The reason for delay is obvious. She has with her not a pellet of mud, but a viscid globule of gum. This has been gathered at some neighbouring tree. What excellent material it is! She is going to strengthen the building with glue.

A process of smearing now begins. It is a slow, laborious business. Three hours were spent in constructing the masonry; for three days she works at smearing the gum. The larger nodules must be cut into fragments, viscid pieces must be severed into tiny parts; all are tenacious and hard to cleave with the simple

instruments at the disposal of the wasp. She spreads the substance round the cell aperture, drags it about and smears it on the wall. It maytake her half an hour to exhaust a single pellet of glue. Her industry is indefatigable. Quiet and methodical patience keeps her for days at this tedious work. Unless prevented by stress of weather, she wastes not a moment of time. Each morning finds her gathering gum, and often she sticks to it unceasingly till dark. Dull weather may keep her idle, but sunshine means continuous toil. When a deluge threatens she will not stir abroad, but shelters with-in her cell.

The mucilage is spread on the outside only. None is carried into the cell. The inside wall must be perfectly smooth. She has already cleared it of irregularities. No rough or sticky nodules must be applied to it which might injure the tender grub.

By means of this gum the cell is strengthened. Fragments of masonry are bound together. The whole is hermetically sealed. The mucilage takes time to harden. For months it remains rough and sticky, an excellent protective coat. Not only does it add great strength to the edifice, but also it gives protection against heat, and acts as a kind of external mackintosh to keep out rain and damp. But there remains, I think, a more important function. The glue must protect the larva from parasites. It is not just a glutinous skin. In places it is raised into sticky lumps on which a parasite could scarcely alight. Thus the gum does not only strengthen and shelter : it may also be a kind of glutinous trap.

I have not seen her gathering this substance. But on the mango trunks in the garden are sticky nodules, concentrated oozings of sap, from which the mason must obtain her gum. Think of the tedious labour required, the digging of jaws into the glutinous material, the kneading, the moulding, the shaping into a ball.

Three or four days finishes the smearing. Before passing on let us look at the pot. It is an oval receptacle, distinctly egg-shaped, neatly rounded and broad at the bottom, truncated at the top to receive a lid. Half an inch broad, three-quarters of an inch long : its widest part is at the middle from where it tapers to either end. The wasp places it horizontally, but in this she shows particular discernment. She gives the cell a slight inclination, raising its mouth above the level of its base. This is a plan to secure safety. The upward tilt will prevent material falling out when provisions are pushed inside.

We now leave the masonry and smearing. I conclude with a detailed table of the work.

Architecture of a Cell of *Rhynchium nitidulum*

Architecture begins

1.	Arr. 2.40 p.m.	5.	Arr. 2.50 p.m.	9.	Arr. 3.23 p.m.
	Dep. 2.41 ,,		Dep. 2.52 ,,		Dep. 3.24 ,,
2.	Arr. 2.42 ,,	6.	Arr. 3.4 ,,	10.	Arr. 3.25 ,,
	Dep. 2.44 ,,		Dep. 3.5 ,,		Dep. 3.27 ,,
3.	Arr. 2.45 ,,	7.	Arr. 3.6 ,,	11.	Arr. 3.29 ,,
	Dep. 2.46 ,,		Dep. 3.8 ,,		Dep. 3.31 ,,
4.	Arr. 2.48 ,,	8.	Arr. 3.10 ,,	12.	Arr. 3.39 ,,
	Dep. 2.49 ,,		Dep. 3.13 ,,		Dep. 3.41 ,,

Architecture—(contd.)

13. Arr. 3.43 p.m.	16. Arr. 4.2 p.m.	19. Arr. 4.20 p.m.
Dep. 3.45 ,,	Dep. 4.4 ,,	Dep. 4.22 ,,
14. Arr. 3.46 ,,	17. Arr. 4.5 ,,	20. Arr. 4.23 ,,
Dep. 3.48 ,,	Dep. 4.7 ,,	Dep. 4.28 ,,
15. Arr. 3.58 ,,	18. Arr. 4.17 ,,	21. Arr. 4.37 ,,
Dep. 4.1 ,,	Dep. 4.19 ,,	Dep. 4.40 ,,

22. Arr. 4.42 p.m. and finishes cell. Dep. 5.3 p.m.
23. Arr. 5.34 p.m. with first load of gum.

Eumenes, immediately her cell is finished, introduces the egg. It is very easy to observe the act. We see her large conical abdomen go down through the cell mouth. But *Rhynchium* is far more reclusive. Her egg-laying takes place in secret, at the bottom of her dark pot. So deep is the cell and she is so concealed in it, that I fail to witness the vital act. But there comes a time when suspicion is aroused. I see her absolutely motionless, rigidly fixed. This must be the moment of emission, when she fulfils the purpose of her life.

Of this, at least, I am quite certain. *Rhynchium* lays her egg when the masonry is finished, but before the smearing of gum. During the short interval between building and smearing I make a hole in the cell wall. This gives light to the dark interior, and enables me to see a single egg anchored to the bottom of the pot. White in colour, of fusiform shape, it is gently curved, about three-sixteenths of an inch long, and fixed by one extremity to the cell wall.

Surely this seems a strange occurrence, this egg-laying in an open cell. For remember that all the smearing must be done before the gate can be closed. This is a work of many days. In the meantime the egg is exposed to any enemy which can enter the gate. Gum smearing, I am sure, is a protective measure; then why is the egg left open to invasion during those days when the smearing is being done? Would it not be safer to retain it till all the protective glue was applied?

It would certainly appear so. The nature of the enemy may explain the inconsistency. Parasites do not enter by the ordinary route. They are not accustomed to open doors. Theirs is a more insidious plan. Armed with ovipositors, they penetrate masonry. Perforation is part of their instinct of attack. Against such devices *Rhynchium* must guard. Her enemy has probably only one way of entrance, by driving its spear through the rampart of mud. It does not understand the open gateway, for it is not its instinct to enter by that route. Consequently the open gate is unimportant provided the cell is covered with glue.

The egg is laid, the wall strengthened. Now comes the storing of supplies. Off goes the wasp in search of plunder. This is a new and brighter occupation, so she swings and hovers in the air. I wait her return. She arrives with a caterpillar in her jaws. She has her victim gripped behind the head with its body supported in her front legs. The caterpillar is a green or brownish species, sometimes of moderate size, but often very small, only about quarter of an inch long. She stuffs it skilfully through the gateway. First pushing it with her head, her body follows, then grasping it farther and farther backwards, she presses it before her

to the bottom of the cell. With her vertex as a ram she forces it well down. A little time is spent adjusting it, screwing it about, compressing it, packing it, making it fit economically inside. This finished, she withraws her head and goes off to get more spoil.

If supplies are abundant she may be back in ten minutes. A second victim is added to the store. At other times half an hour is insufficient. In gloomy weather, or when rain threatens, she may not get a capture for the whole day. Again there are times when she can get nothing. On such occasions all her work may be wasted. Famine may force her to abandon the cell. All this foraging is done as quickly as possible. Whenever not engaged at hunting she keeps strict watch on her accumulating store. For example, she always sleeps in the cell, seated on top of the pile of caterpillars, with body bent into the cavity and tips of antennæ projecting outside. Also, when the sky is overhung with clouds she similarly keeps close guard over the store.

Provisioning continues till the cell is full, packed tight to the very mouth. This may require fifty or more caterpillars, they are often so miserably small. And not only must she find them ; they must also be paralysed. Such is the method adopted by her tribe. What infinite labour does not this involve ? Let us make a search for her kind of caterpillar ; if fortunate, in an hour we may find one or two. Yet the wasp has to hunt out fifty or more of them before she can close her cell. We have seen her industry at building operations ; she is equally persistent at pursuing prey.

The stores are in ; they are tightly packed, the chamber is filled to the mouth. The next piece of work is to seal them down, a lid must be placed over the gate. Here we see a rapid operation. The mason brings a pellet of the usual type, and in a minute constructs round the opening a narrow ledge of mud. Sometimes there may be a slight interruption. since the wasp may have to push in her head in order to press the squirming larvæ down. This first ledge closes the aperture partially, but after a minute she brings a second load. This is moulded to the first ledge, and is usually sufficient to complete the lid. Then comes the touching and testing with antennæ to make sure that the work is sound. Without a moment's delay she proceeds to strengthen it. She does not even go off for material, but cuts a little resin from the outside wall and spreads it over the lid. Ten or fifteen minutes are spent reinforcing it, and the gate is permanently closed.

Now surely is the hour of rest. Building, smearing, provisioning are done. But this mason is indefatigable. No sooner is this cell finished than she immediately commences the next.

What a laborious builder to toil so incessantly day after day. The largest nest I have seen contained twelve chambers. If we give an average of five days for the building of each, then the work of the whole nest must have occupied about two months.

Rhynchium is well able to defend her nest. Her attitude within it has protective value. She is bent double ; her back thrust down into the cavity, the end of her abdomen and tips of antennæ turned up into the gate. I bring my finger to the gateway. No sooner have I touched it than out comes the sting which the wasp im-

mediately drives home. For a minute the pain is acute, almost equal to that of the hive bee. But the poison of *Rhynchium* is less lasting. There is no numbness. Her defence is just enough to repel an enemy when it appears at the open gate.

Now that the work is finished, let us see what goes on within the cell.

Development

Cells are examined at successive intervals. I open the first after the lid has been secured. The wasp has spent three days in provisioning it, but this has not prevented egg-development. The egg has hatched, though the cell remained open. Indeed by now it is a vigorous larva that lies curled at the bottom of the pot. Above it are the caterpillars heaped in a solid mass. The larva has begun to feed. From below it is eating up into the supplies. In this particular cell are forty-one caterpillars, and some have already been devoured. All are of the slender kind, and are pressed firmly together so as to occupy the smallest space.

I open the next cell two days after the lid is sealed. The larva has grown into a huge maggot, stout and fleshy, that almost fills the cell. Pale yellow, curved in outline, its separate segments are visible as rings. Its head end is pointed with curved jaws which are fixed in the tissues of the prey. The hind end is distinctly larger and distended with succulent food. Its length is now three-quarters of an inch, but its body is so neatly curved that it fits economically into the cell. By this time the food is almost consumed. Only two caterpillars remain. One is still alive. I touch it with a pin. Its body bends, limbs twitch, it lies in the same half paralysed state as when first pushed into the cell. The other caterpillar is partially consumed, and the jaws of the larva are embedded in its flank. The others have disappeared. They have passed into the tissues of the larva and a few nodules of stercoral matter that lie at the bottom of the pot.

Two weeks after egg-laying I open a third cell. The larva has changed into a pupa, a miniature of the future wasp. It rests motionless without a sign of life. Eyes are now distinct, antennæ well formed, even the delicate mouth filaments can be distinctly seen. It is pale white, almost colourless, with on either side a dark stump which marks the developing wing.

Three weeks after egg-laying a fourth cell is examined. A well-formed wasp now occupies the chamber, filling the available space. Its head is just within the door with jaws in position to cut through. Now black like the adult, its wings are still unfolded as though not quite ready to emerge. It moves freely in the narrow prison, legs quiver, antennæ tremble, it even protrudes a sting. Nevertheless these movements are hampered since the whole body is enveloped in a skein.

Emergence takes place on the twenty-sixth day. The young wasp excises the lid by gnawing round the edge. She comes out through the opening, but does not immediately take to flight. I observe that for some days she remains on the cluster, often sitting in the cell for hours with only the tips of her antennæ outside. A

short flight may be taken at intervals, but her wings are still weak and she soon returns.

At length she disappears. The cell becomes an empty pot with only some refuse inside. Still it is not useless. *Eumenes* builds a cell, closes it, abandons it; but *Rhynchium* will utilize her cell again. She will sweep it of refuse, again lay in it, reprovision it, and close it with a new lid.

But even more. Winter supervenes. *Rhynchium* disappears completely, probably to hibernate in some sheltered hole. Her nest remains stuck firmly to the woodwork and thickly grimed with dust. April arrives. *Rhynchium* awakens from her long slumber to resume the unremitting toil. Unexpectedly I see the nest re-occupied. Surely it is the builder of last year returning to the old cell. I cannot be certain. A wanderer of the same species may have chanced upon it. But *Rhynchium*, as we have seen, is very constant; and I prefer to think that the original foundress remembers the first home.

Now we see how *Rhynchium* gains by expending such labour on her cell. Compared with *Eumenes* the toil is immense. *Eumenes* builds a cell in a few hours, lays in it, provisions it, then sees it no more. But *Rhynchium* spends days at architecture: the building of her cluster occupies weeks. The difference is that *Rhynchium* makes a permanent habitation. She sticks to it throughout the season and may return to it the following year.

Geometry

I come now to some points about geometry. I want to show how the mason measures, how she gets the shape and limits of her cell. There are certain geometrical principles underlying this delicate work.

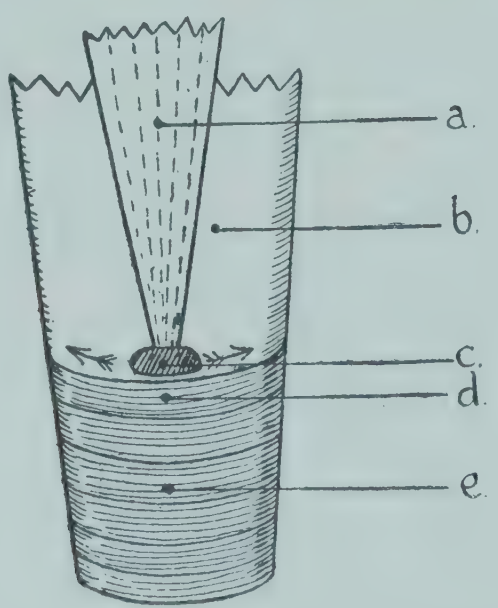
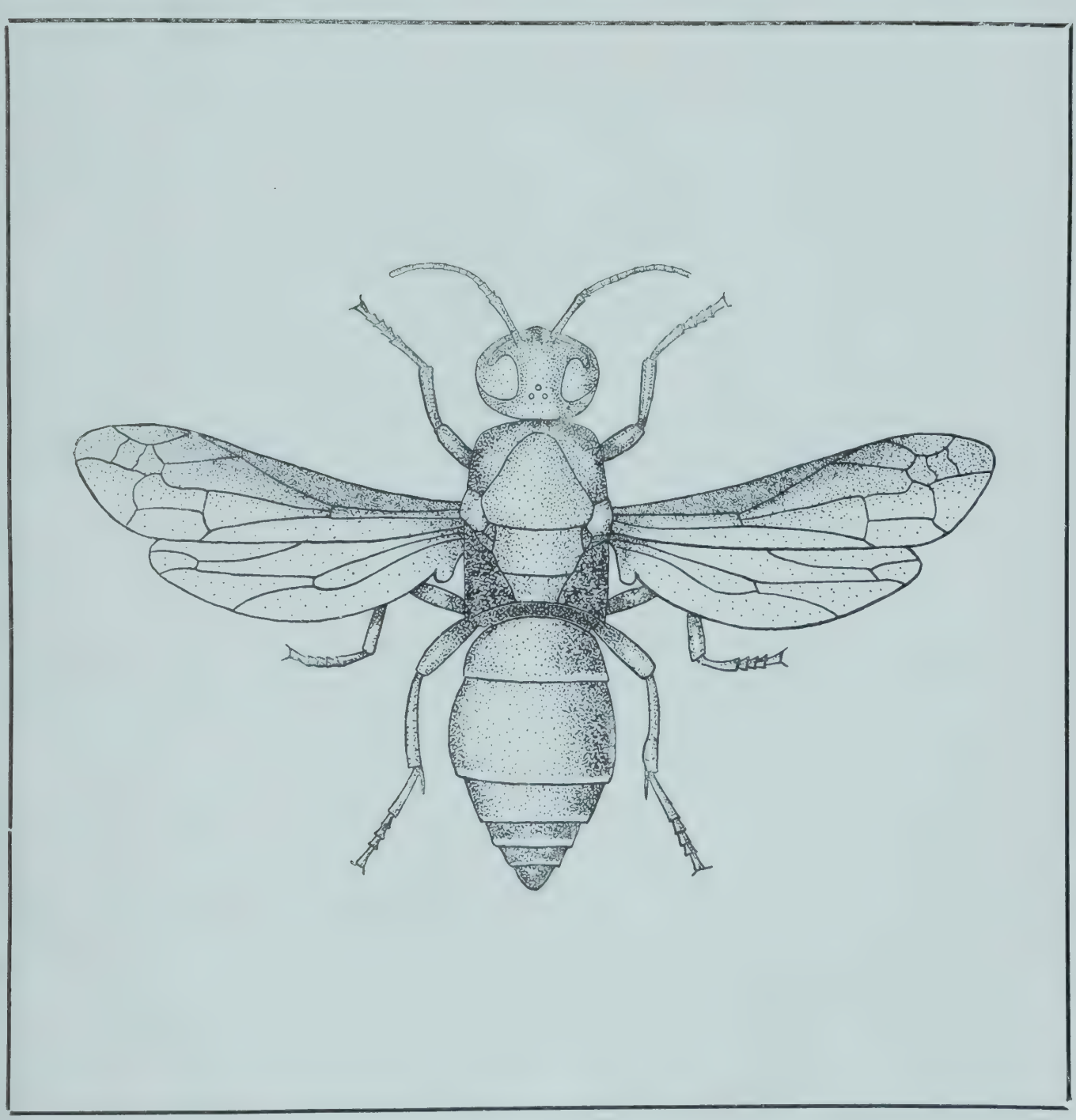
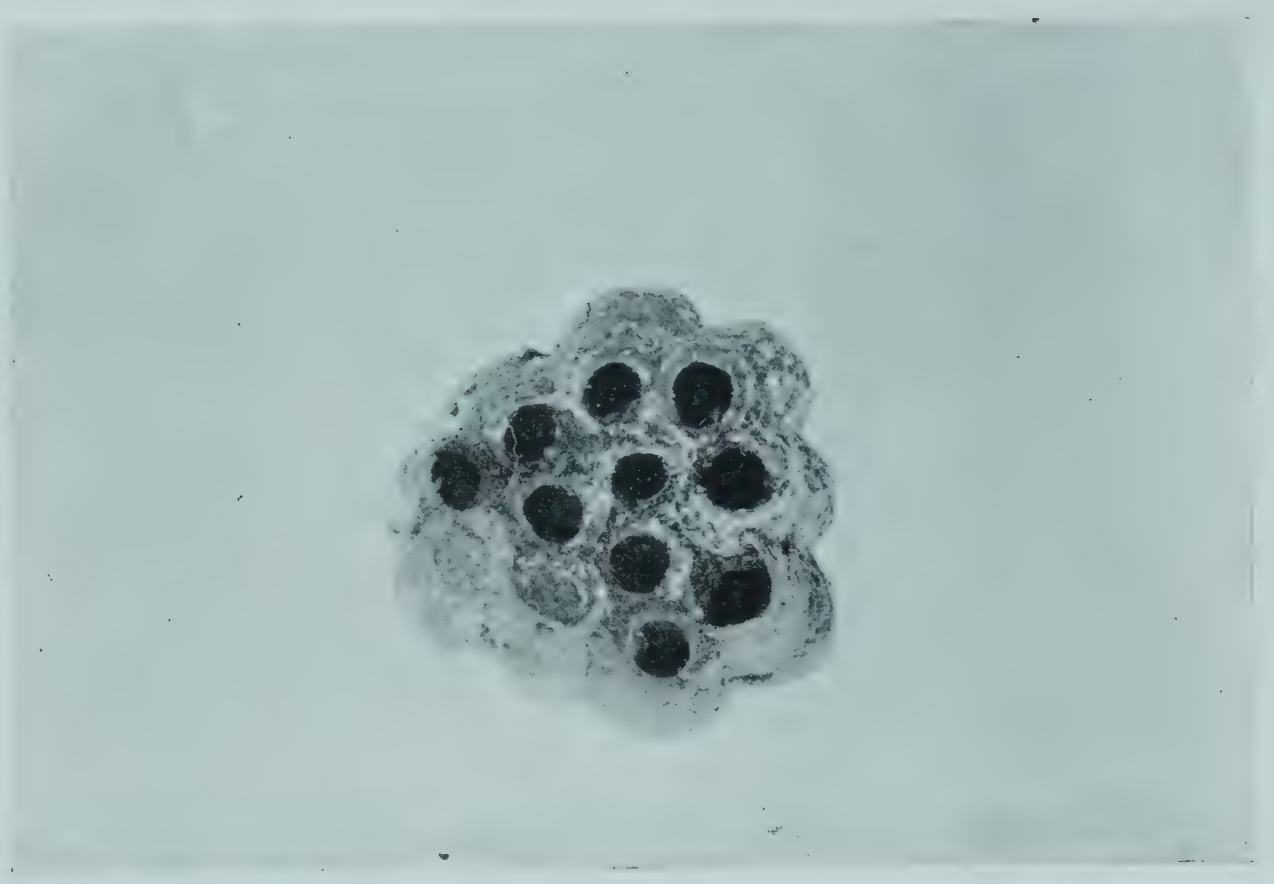


Fig 1. DIAGRAM TO SHOW PENDULUM MECHANISM OF WASP.

a. Pendulum corresponding to wasp.
b. Surface of completed cells.
c. Pellet at point of pendulum.
d. Top of wall.
e. Wall of cell undergoing construction.



THE POTTER WASP.
(*Rhynchium nitidulum*).



NEST OF THE POTTER WASP (*Rhynchium nitidulum*).



Rhynchium BUILDING LOWER HALF OF CELL.

I recall the method of building. First the wasp hangs head downward, swings from side to side, rolling her pellet from the centre to either end of the wall. Then she reverses, sits upright in her cell and rolls her pellet from end to end. Now I want to explain all this. Why are these attitudes and changes necessary to the shape and perfection of the cell.

First the wasp hangs head downward and swings from side to side. In fact she is a kind of pendulum. But her swings are not quite those of an ordinary pendulum. They not only swing her from side to side, but they also carry her forward in a curve. Thus at first we see a simple mechanism, a pendulum that swings and sweeps a forward curve. (Fig. 1.)

But there is more geometry about it than this. As the wall grows higher the wasp does not retreat upward. In fact the base of the pendulum remains fixed. What then must happen as the wall rises? Since the pendulum will not retreat, then it must tilt more and more forward after each fresh addition to the wall. It will occupy successively the positions 1, 2, 3, 4, 5, as shown in the accompanying sketch. (Fig. 2.) What will be the consequence? The pendulum,

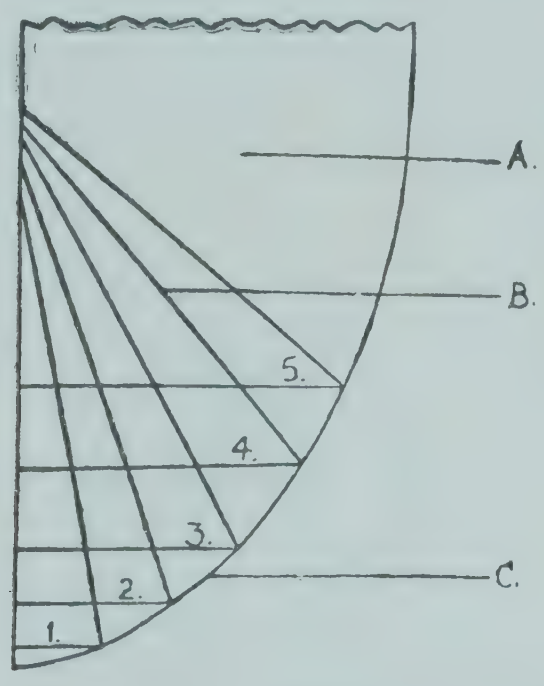


FIG. 2. DIAGRAM TO SHOW FORWARD TILT OF PENDULUM.

A. Wall of cell.
B. Line of pendulum.
C. Front wall of cell.
1-5. Successive levels occupied by pendulum.

after each addition to the wall, will swing through a larger arc than it did on the previous swing. Each successive pellet will be moulded into a larger curve. Hence the capacity of the growing cell will uniformly and geometrically increase.

Another point. The pellet, as I have said, is at this stage first placed at the centre of the wall, and from there rolled to one or other end. Why is this? When we regard the wasp as a pendulum I think we can explain the act. For, as we have seen, the curve increases

at each fresh addition to the wall. But this increase in curve is mainly at the centre; there is little increase at the ends of the wall. There the wall is fairly straight without very much change in curve. Therefore when the mason is shaping her curve she will estimate it better by commencing at the centre instead of at the ends of the wall. By commencing there she tilts out the pendulum to the full extent of the new curve, and then gradually diminishes the arc as she rolls the pellet to either end. This is no doubt an easier operation than if she were to try to draw a curve by one sweep from end to end.

When the wall is half-built the change in method of construction takes place. The mason now gets into her cell, sits erect with head at the edge, and rolls her pellet along the wall.

There must be a reason for this change. I think this is the explanation. The change takes place when the cell has reached its greatest width. During the lower half of its construction the size has been increasing; from now on its width becomes less. In order to effect this change in size the mason has to alter her method of work. The principle of the pendulum, as I have shown, increases the curve at every swing. If she persisted at the pendulum mechanism then her cell would grow larger and larger; it could never graduate into an egg shape. Hence a change of some kind is necessary. See how it works. She gets into the cell, sits upright in it, and rotates from side to side. She is no longer a swinging pendulum, but a vertical pivot that rotates. Her head is bent over the edge of the wall. And as she turns within the cell, she draws out the clay into a curve. Now as the wall grows higher it becomes necessary for her to stretch further upward in order to mould the pellet on the edge. In order to compensate for this she makes each curve a little smaller than the preceding curve. And since the curves become successively smaller, therefore the size of the upper half of the cell grows gradually less.

Nor need the mason now commence at the centre and roll her pellet to one or other end. This was necessary in the lower half, for the curves were then increasing at each swing, and the wasp could do better by taking her measurement from the point farthest away on the curve. But now the reverse happens. The curves are decreasing at every swing. Hence the mason must change her method. Now she measures from the nearest point, therefore commences at one end and rolls the whole length of the wall.

My description may not be sufficiently clear. I will illustrate it by a simple comparison. Imagine a man standing upright with his arm hanging down in front of him. The right arm represents the pendulum, the hand corresponding to the head, the arm to the body of the wasp. Now the hand is going to trace the building movements. First it oscillates from side to side like the wasp laying its first layers. As construction advances, the hand, of course, is raised. It is at the same time tilted forward. As a result it traces a curve and each curve is larger than the preceding curve. Thus the action of the hand is like that of the wasp when building the lower half of her cell.

At length the arm becomes horizontal. That will correspond to the point when the cell is half built. The arm is now out at full length and the greatest diameter of the curve is reached. A change in direction must now take place. The wasp, I have shown, reverses position. From working head down, it changes to head up. A similar reversal occurs with the arm. Follow the hand upward. It gets above the horizontal. The shoulder is still the pivot. But up till now the hand had worked below the pivot: henceforward it will work above. It continues to draw out curves, but, as it rises, it approaches the plane of the body. Consequently each curve is smaller than the one which precedes it. If the hand were building a cell, then the capacity of the cell will decrease. This is a very rough comparison, but it represents the mechanism of the wasp.

Just one more point before we leave the architecture. How does the architect estimate height? How does she know when to cease adding to the wall? It might be thought that the problem would present itself only at the building of the first cell. After that she would have a standard of measurement. The first cell would serve as a pattern, and the others could be raised to an equal height. But a simple observation disproves this. The wasp does not compare heights. There is one plan of measurement which she applies to all the cells. For, sometimes, when adding a cell to the cluster, she may not commence at the same level as she did with the preceding cells. On the contrary, as shown in the illustration (Fig. 3), she

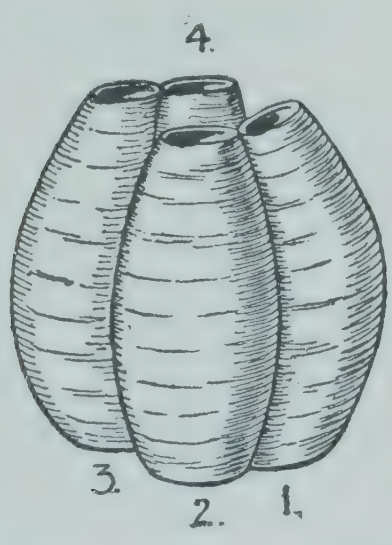


FIG. 3. CELLS OF *Rhynchium nitidulum* AT DIFFERENT LEVELS
Order of construction: 1, 2, 3, 4.

begins a little higher up. It will then be observed that the top of this cell is not finished off flush with the preceding cells, but is raised as much above their tops as its point of commencement is above their bases.

It seems, therefore, that the wasp can estimate the height of each separate cell. Watch her and see the method of measurement. Nothing could be more simple. During the second half of construction she works, as I have said, within the cell. Her attitude is erect, tip of abdomen at the bottom of the chamber, antennæ at the edge of the wall. These are the points by which she measures. She knows that her cell is sufficiently high when the tip of her abdomen just touches the bottom and the tips of her antennæ just reach the gate. The height of a cell is three-quarters of an inch. That too is the length of the wasp between these extreme points. I have frequently shown how insects measure. Here we see one of the simplest mechanisms. The mason employs her own length to measure the cell height.

Honey-bees are the most skilful architects. Working in darkness they shape pyramids and hexagons. They are geometricians in the highest sense. These workers in clay have not their efficiency. Nevertheless they are geometricians. The particular shapes and dimensions of their cells depend on mathematical skill. Different species display different methods, *Eumenes*, by expanding her antennæ widely, can measure out the cell base, by employing them as a pair of dividers can shape a circular door, by using them as a vertical plumb line can determine the cell depth. In *Rhynchium* we observe the pendulum and pivot. Also the simplest of all mechanisms, the measurement of cell height by comparing it with body length.

(*To be continued*)



ANIMAL LIFE IN TORRENTIAL STREAMS[1]

[A Public Lecture delivered at the Fourteenth Annual Meeting of the Indian Science Congress at Lahore on January 8, 1927.]

BY

DR. S. L. HORA, D. SC.

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(*With one plate and ten text-figures*)

SIR JAGDISH, LADIES AND GENTLEMEN,

The subject which I have the honour to bring before you this evening is that of Animal Life in Torrential Streams. I presume that most of you are familiar with what I mean by torrential streams because they are so abundant in all our hills and especially in those hills where the rainfall is high. Just to refresh your memory I shall take you to the Khasi Hills, which are noted for the heaviest rainfall in the world. 'The average annual rainfall at Cherrapunji, a village on the southern face of the hills, is no less than 458 inches. Enormous though this rainfall is, it is little more than half of the maximum on record. In 1861, 905 inches fell, 366 of which were assigned to July alone. The maximum for a single day was, however, recorded in 1876, when 41 inches of rain fell in 24 hours.'[2] It will not be out of place to point out for the sake of comparison that the average annual rainfall of the city of Lahore is nearly 21 inches, which is approximately half of the actual rainfall recorded on a single day at Cherrapunji. The Cherrapunji plateau is admirably drained, and the water is quickly carried off. The streams in the deep gorges swell immensely during and after a heavy fall of rain. Mr. Oldham,[3] who visited one of the streams in these hills after a heavy and sudden fall of rain, describes the scene thus:—'The water had then arisen only about thirteen feet above the level at which it stood a few days previously; the rush was tremendous—huge blocks of rock measuring some feet across, were rolled along with an awful crashing, almost as easily as pebbles in an ordinary stream. In one night a block of granite,

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[1] The lecture was illustrated with 39 lantern slides, most of which were prepared either from specimens collected by the author or from sketches and photographs made by Babu D. N. Bagchi in the field under the author's supervision.

[2] Allen, *Assam District Gazetteer*, vol. x, p. 30 (1906).

[3] Oldham, *Mem. Geol. Surv. India*, vol. i, p. 174 (1859).

which I calculated to weigh upwards of 350 tons, was moved for more than 100 yards ; while the torrent was actually turbid with pebbles of some inches in size, suspended almost like mud in the rushing stream.' We have here to consider how animals manage to live under such adverse conditions. Besides the rapidity of the flow of water we find that the only kind of food available consists of algal slime covering stones and rocks, for there is little chance of any other type of vegetation to grow as it is liable to be uprooted and carried away by the strength of the current. Very rarely a growth of moss and of higher plants is found in swift currents. Insect larvæ of various kinds are found in fair abundance in these streams and they form a valuable supply of fish food, but it should not be forgotten that the ultimate source of food is the algal slime. Among other conditions that influence the fauna of hill-streams may be mentioned the abundance of shelter, the clearness and shallowness of water during the non-rainy season and consequently intense light during the day-time and lastly the presence of a large quantity of air dissolved in the water.

To adapt themselves to such a peculiar environment the animals have modified their entire organization. In the case of fishes,[1] for instance, we notice that modifications have taken place in the external form, the scale covering, the fins, the mouth, the lips, the jaws, the eyes, the gill-openings, the air bladder, the skeletal and muscular frame work and lastly we find that special modifications of the skin have occurred in places. I have not enough time this evening to discuss the entire set of adaptations, but with your permission I shall confine myself to the external form of the animals and to the special structures that enable them to withstand the swiftness of the currents.

In 1891, Nikolsky[2] dealt with the correlation between the shape of the body of fishes and the strength of the current of streams, but unfortunately his work is not available in India and I have not been able to consult it. I have, however, made extensive observations on this point and I propose to give you a summary of my views on the subject.

In general, fishes are boat-shaped, adapted for swift progress through water. They are longer than broad or deep and the greatest width is in front of the middle leaving the compressed paddle-like tail as the chief organ of locomotion. We get such forms in the sluggish waters of our rivers in the plains and in tanks and ponds, but at the base of the hills where streams possess rocky beds and water flows with some rapidity, the fishes that are met with are more or less of a cylindrical form and are provided with a strong caudal peduncle and a well developed tail fin. The cylindrical form probably does not present so much surface to the strong flow of water as the usual form of the fish and the muscular tail becomes a great asset for progression in swift currents. As we go higher up

[1] Hora, *Rec. Ind. Mus.*, xxiv, pp. 33-61 (1922).
[2] Nikolsky. *Rev. Soc. Nat. St. Petersb.* pp. 137–139 (1891).



Fig. 1.—*Balitora brucei*, Gray, from Nong-priang Stream below Cherrapunji.

in the hills and study the fish fauna of the torrents, it is found that the form is greatly depressed from above downwards, and in some cases it has become almost leaf-like. The under surface is greatly flattened and has developed adhesive organs for clinging to the rocks in these rapid waters and the tail has become very muscular and whip-like to enable the fish to dart about from one rock to another in swift water. The upper surface has assumed a stream-line form so that it presents less resistance to swift currents.

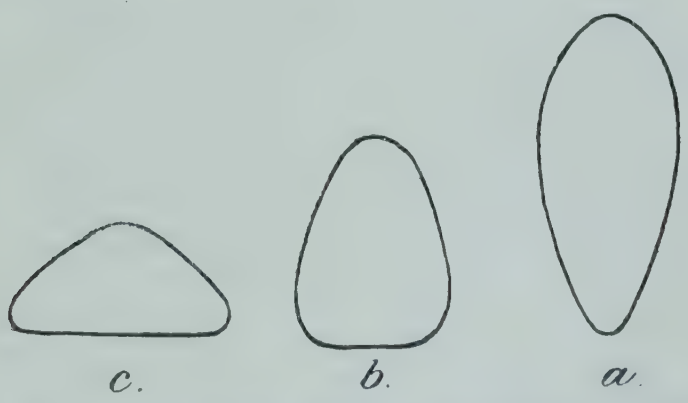


Fig. 2.—Transverse sections of fish showing evolution of form for life in rapid running waters.

(*a*) Section of an ordinary pond fish (*Labeo*).
(*b*) Section of a fish living in moderately swift currents and relatively deeper waters (*Schizothorax*).
(*c*) Section of a typical torrent-inhabiting fish (*Balitora*).

Among fishes I have been able to find two types of adhesive organs,[1] firstly a rounded or elliptical structure with a large callous portion in the centre and a loose membranous flap all round it and secondly an organ composed of grooves and ridges. The former functions as a true sucker by the creation of a vacuum, while the latter in my opinion acts as a mechanical frictional device and prevents the fish from slipping. The true sucker is present in the members of the genus *Garra*, while some sort of a frictional device is present in almost all hill-stream fishes. The latter device possesses one great advantage over the former and it is this:—a vacuum of a certain capacity can have only limited power of adhesion whereas in a frictional device the friction increases with pressure, which under the circumstances is proportional to the rapidity of the flow of water. In streams subject to a sudden rush of water an adhesive apparatus of variable efficiency is very beneficial. Moreover, adhesion by a sucker requires constant exertion on the part of the animal using it, whereas a frictional device acts mechanically, meeting effectively the exigencies of the circumstances.

A powerful sucker occurs in the tadpoles of the section *Rana formosa*. I was afforded an opportunity of testing the efficacy of this mechanism by making a series of observations on the living tadpoles of *Rana afghana* in the Khasi Hills and at Dharmsala in the Kangra Valley. A tadpole was held by its tail and was then placed on a loose piece of stone in water in such a way that its sucker touched the stone. The animal was then lifted out of water by the tail and it was found that the stone was also lifted with the tadpole. By repeating this experiment with stones of different sizes, it was found that a tadpole weighing one-tenth of an ounce could easily, when lifted out of the water, retain a hold on a stone having a weight of about six ounces.

I have here to refer to some very peculiar tadpoles of certain species of the genus *Megalophrys*. Great controversy has raged round the function of the funnel apparatus and a considerable literature has grown round the subject. I made the acquaintance of these tadpoles at Dumpep in the Khasi Hills and found them in abundance in a rapid flowing, rocky stream among weeds and under stones or in crevices in the rocks in sheltered places. To me[2] it at first seemed probable that the two inwardly curved horns of the folded funnel enable the animal to anchor itself among weeds in fairly rapid currents. But further observations carried out in the stream bed itself have convinced me that the peculiar funnel is only a device for gathering plancton on which the animal feeds and that it helps to keep the anterior end buoyant, so that the animal does not knock against rocks if it happens to be swept away by a strong current.

The structural modifications of the fish and of the Batrachian larvae that inhabit our small mountain torrents afford a remarkable instance of parallel evolution or what Annandale and myself[3] have

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[1] Hora, *Rec. Ind. Mus.*, vol. xxv, pp. 587–591 (1923).
[2] *Ibid.*, pp. 585–587 (1923).
[3] Annandale and Hora, *Rec. Ind. Mus.*, xxiv, pp. 505–509 (1922).

called 'communal convergence.' You must have noticed the great similarity in external form and in the structure of the sucker of *Garra* and of the tadpole of *Rana afghana*. In the former we know that these modifications are the results of a series of gradual changes to be observed both in the post-embryonic development, in individual variability and in specific differentiation. In the larvae of *Rana formosa*, however, we know, so to speak, the finished product of evolution in the highly perfected organ of adhesion. In the case of *Garra* at any rate, we have evidence that these changes have resulted, not through mutation or by any Mendelian segregation of characters, but through a gradual accumulation of small changes.[1] The close correlation between these structural changes and differences in the flow of water in which species and even individuals live is at any rate suggestive. Whether in these particular cases we are witnessing the survival of the fittest in the Darwinian sense, which means the evolution of new structures through the agency of small fluctuating variations, or must accept a frankly Lamarckian explanation, which means the evolution of new structures by the constant use or disuse of the parts affected, only experiment can prove.

The Gastropod molluscs that live actually in rapid waters, such as species of *Paludomus*, or which live on rocks at the sides of streams subject to a sudden rush of water, such as *Cremnochonchus syhadrensis*, *Neritina perotettiana*, *Lithotis rupicula* and *Turbinicola saxea*, have solved the problem of existence in their particular habitat by the greatly increased size of the foot and a consequently increased power of attachment. In the case of *Paludomus* the upper whorls are usually worn and the shell comes to resemble the small rounded pebbles among which it usually lives. Among the Gastropod molluscs, however, special mention may be made of the various species of the genus *Ancylus* which inhabit swift currents and are limpet-like in form. They probably stick to stones or other objects by the creation of a sucker in the strict sense of the term. Certain bivalves, such as *Corbicula*, are also found in rapid water, but they manage to live during floods by seeking shelter under rocks or by burrowing in sand. One species of bivalve from the Surma Valley,[2] Assam, has developed this habit to an extraordinary degree. It lives, firmly anchored by its extensive foot, in regular burrows formed either in hard blue clay or in friable sand-stone rocks. It has thus avoided the dangers of swift currents in a most ingenious way. I shall have occasion to refer again later to this mode of life in hill-streams, when dealing with the insect larvae.

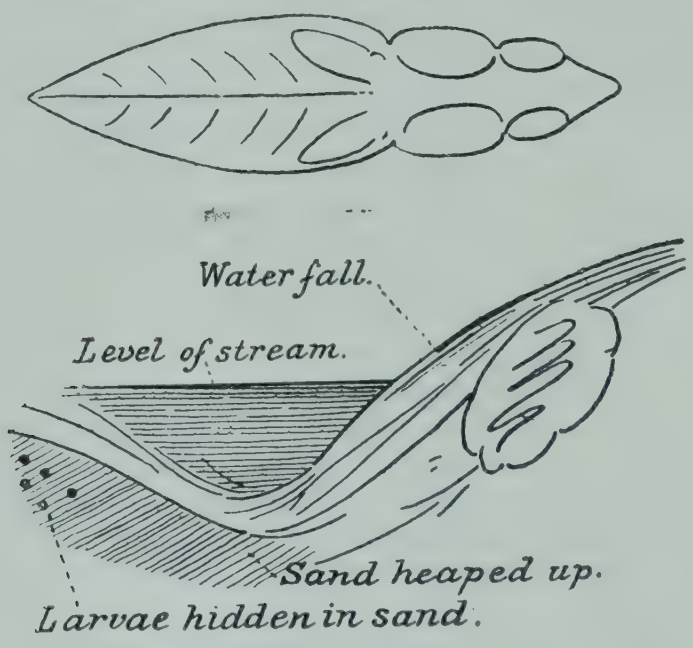
Leeches are also met with in hill-streams but you are probably aware that these animals are provided with well-developed suckers. Those from rapid waters have these suckers better developed. I also found a colony of Polyzoa, or moss-like animals, in rapid water in the Kangra Valley.[3] This is an encrusting form, so that once it is attached to stones it needs no further specialization. The

[1] Hora, *Rec. Ind. Mus.*, xxii, p. 640 (1921).
[2] Hora, *Journ. Asiat. Soc., Bengal* (in Press).
[3] *Ibid.*

occurrence of Polyzoa in running water is a rare phenomenon and Annandale observed it only once, in *Plumatella fruiticosa*, in a small jungle stream in Travancore. My specimen from the Kangra Valley also belongs to the same species but it is remarkable that only the form *stricta* of this species occurs in running water, and it seems probable, as Annandale has pointed out, that this form is found only in those places where there is reason to suspect a lack of minute life and, therefore, of food.[1] I have collected a number of Turbellarians or flat worms in hill-streams, but have not so far made a special study of these animals. They are broad, flat and leaf-like and encrust stones and rocks in rapid waters, and Prof. Stanley Gardiner of Cambridge University has very kindly informed me in a private communication that these forms also possess specially modified clinging organs.

Insect larvae of various kinds occur in mountain torrents in large numbers and are remarkably well adapted for life in such situations.[2] I propose to deal with the various groups one by one.

The dragonfly larvae of our torrential streams can be divided into four groups. The first group bury themselves in the sand at the bottom of pools in streams. These are generally found to belong to the Gomphines with a torpedo or stream-line body adapted for pushing forward through sand or facing heavy currents. The legs are



(*From a drawing by Col. Fraser*)

Fig 3.—The form and habitat of Gomphine larvae.

short and adapted for burrowing. These larvae frequent particular spots, usually in front of the foot of a falling column of water, where the water has scoured out the sand and heaped it up down stream. I have illustrated this type by *Macrogomphus wynadicus* and *Megalogomphus hameyngtoni*. The siphon-like tube at the posterior end of

[1] Annandale, *Faun. Brit. India, Freshwater Sponges, Hydrozoa and Polyzoa*, p. 219 (1911).

[2] Musgrave and Campbell, *Austral. Mus. Mag. Sydney*, iii, pp. 28-31 (1927).

the abdomen of the former is the only part of the larva which projects from the sand. These larvae are rectal breathers and hence the utility of such a device is perfectly obvious.

The second group includes limpet-like forms such as *Ictinus* and *Zygonyx* which are actual water-fall dwellers. The belly is absolutely flat and is very broad, the back is highly arched like a limpet and slopes steeply away on either side. They live on rocks and are able to hold their own against the heaviest torrents. It has been believed that adhesion is due to the close application of the ventral plates to a rock and by the creation of vacuum by contraction of the plates. Personally I have no idea as to how far this view may be correct but my examination has revealed the presence of definite adhesive pads on the ventral plates; these pads are very much like the lamellae on the sucker of *Echenei* or the ship holder and are provided with spines, thus forming an efficient frictional device. *Ictinus* and *Zygonyx* belong to widely-separated families but from a similarity of habitat have become modelled alike. The former are Gomphines and the latter Libellulines but the resemblance is so close that an expert might be deceived. These two provide another instance of communal convergence.

The third group comprises root-dwellers and these are found clinging to roots along the river banks, swayed from side to side with every eddy of the current. These are long, thin, attenuated larvae resembling stick-insects. They lie close to the roots and

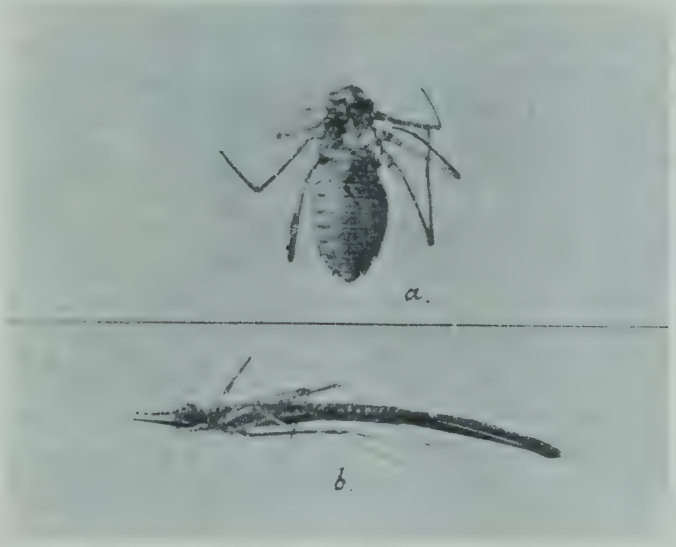


Fig. 4.—Root-dwelling dragonfly larvae of torrential streams.
(*a*) *Macromia ida*, Fraser; (*b*) *Matrona basilaris*, Selys.

thus offer a very small surface to the force of the current. I shall mention here two instances illustrating this group, firstly *Matrona basilaris*, a Calopterygine larva, and secondly the spidery-legged *Macromia ida* a Libelluline larva.

There is yet a fourth group which is found hidden amongst the leafy debris collected in deep pools in the course of mountain streams. These are broad, flat and leaf-like.

I must express here my great indebtedness to Lt.-Col. F. C. Fraser

for sending me valuable notes regarding the habits of the fly larvae of hill-streams and for supplying me with specimens for illustrating this lecture.

Among the mayfly nymphs we find adaptations similar to those that I have already shown you in the dragonfly larvae. Here we have burrowing larvae such as those of *Palingenia* and *Polymitarcys;* creeping larvae that anchor themselves on water weeds and stones in swift currents and lastly those larvae that possess flattened bodies. These last are of the *Ecydurus* and the *Heptagenia* type and are usually met with either on the under side of stones in swift current or on the upper sides of rocks in deeper waters. Some of these larvae, both of the clinging type, which are long and thin, and of the flattened type which possess a limpet-like form, frequent bare rocks in very rapid waters. In all these forms very strong claws are developed for grappling on to the rocks and stones, but in certain larvae of the flattened type that frequent the upper sides of rocks in strong currents the tracheal gills are greatly enlarged and are arranged in such a way that a complete or a partial sucker is formed on the under side of the animal when needed. In addition they are provided with a series of pads beset with spines on the under surface of the tracheal gills. A combination of these two devices makes the under surface thoroughly non-slippery. The highest development of the sucker is reached in the nymphs of the archaic genus *Prosopistoma*, which, according to Eaton [1] 'is exceptional in having the body oval in outline, convex above and flattened beneath ; and it possesses the faculty of adhering firmly by suction, like a limpet, to stones.'

The stone-fly nymphs usually occur in situations similar to those of the mayfly larvae of *Ecydurus* and *Heptagenia* types. They are fairly common, but always on the under side of the stones, in such places where water runs swiftly over a bed of comparatively small pebbles. The nymphs cling closely and lie flat with legs outspread ; they hold on by means of stout paired claws that are like grappling hooks. Their legs are flattened and laid down against the stone in such a way that they offer little resistance to the passing current. The efficiency of the claws for grappling can be readily tested by allowing a larva to crawl on the back of one's hand or on one's arm. They are very quick in their movements and are known to be the worst carnivores of torrent fauna.

The larvae of the *Trichoptera* or the so-called caddis-worms are found in all sorts of inland waters. They build a shelter for themselves and drag it along wherever they go. The case or shelter is held fast by the two very powerful, hooked claws at the hinder end. Several of them are found in rapid waters where they have devised several interesting ways to withstand the rush of water. Some fasten their cases to rocks in swift currents by means of their salivary secretion in such a way that a stream-line form is presented to the current and the animal lives with the open end of the case up-stream. The case itself is greatly flattened on the under surface to come

[1] Eaton, *Trans. Linn. Soc. London. Zoology* (*2*), iii, p. 13 (1888).

in close contact with the support. Some weave a sort of a conical web on the rocks or on water plants growing in swift currents and themselves sit comfortably in its pointed portion and wait for any booty that the current may bring into their web. I have observed



Fig. 5.—Trichopterous larvae (caddis-worms) from torrential streams in India.

certain others that live on the under side of rocks in swift water forming a barricade of small stones and spinning a web over it with a hole for the animal to come out through. Most remarkable among these worms are those in which the case has taken a limpet-like form and the animal is thus enabled to cling fast in very rapid waters.

From among beetles I want to draw your special attention to the remarkable larvae of the genus *Psephenus*, commonly known as 'water-pennies.' They occur in swift streams chiefly on the under-side of stones and are known to be especially abundant in the rapids of Niagara, but are by no means uncommon in our Himalayan streams from Darjeeling to the Kangra valley and in the Khasi Hills. They are greatly depressed from above downwards and are almost

scale-like in appearance. Their form is either rounded or ovoid. The whole of the under surface of the body appears to act as a sucker and it is very difficult to dislodge these larvae with the fingers.

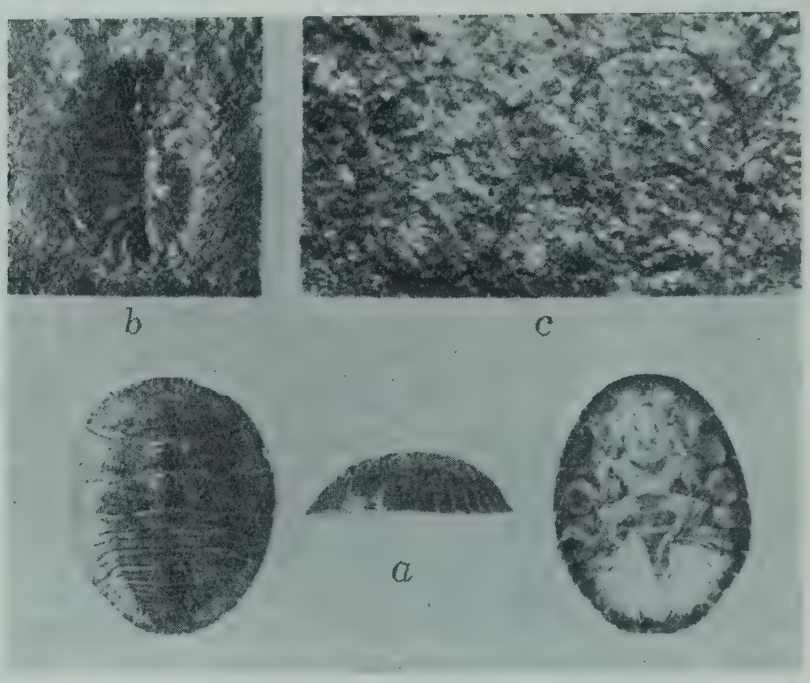


Fig. 6.—*Psephenus* larva and pupa from the Kangra Valley, Punjab.
(*a*) Three views of a larva; (*b*) Pupa soldered on to a rock; (*c*) Scars left on a rock after the pupal skins are washed away.

The pupae are more or less similiar to the larvae, but they are soldered down to the rocks. After the emergence of the beetle, when the pupal skin becomes disintegrated and is washed away, a black oval ring is left to mark the place. The black outline shows the marginal region along which they had been soldered down to the stones. This sort of a permanent adhesion is effected by the secretion of some sticky substance, which leaves black marks on the stones.

The beetles of the family to which *Psephenus* belongs are found for the most part near running water or clinging by means of their strong claws to water plants or other submerged objects. Certain other beetles have also been observed in similar circumstances, but they do not possess any special organs of attachment other than their powerful claws. The under surface is more or less flattened in all beetles, but it is more so in those that frequent rapid waters.

Among the *Diptera, Nematocera* or the midge-like flies, there are two remarkable families, whose larvae live on bare rocks in the course of very rapid waters. I here refer to the blood-sucking black-flies (*Simuliidae*) and the net-winged midges (*Blepharsceridae*). A *Simulium* larva is a small bag-shaped, cylindrical creature somewhat broader at the posterior end. It is usually found sticking by its so-called posterior sucker either to water plants that

grow in swift currents or to the upper surface of rocks and stones in rapid waters. It hangs from its support with the head pointing



Fig. 7.—The larvae and pupae of the blood-sucking black-flies' (*Simullidae*).

(*a*) Larvae and pupae on water weed (*Eriocaulon miserum*) growing in very swift current. (The artist has not been able to do full justice to the number of larvae that are usually found in similar situations.)

(*b*) A blade of the same weed showing larvae and pupae in various postures.

(*c*) Shows a larva crawling back to its support.

(*d*) A portion of the track left behind by a *Simulium* larvae on a glass slide (highly magnified).

down-stream in such a way that a stream-line form is presented to the current. Its posterior appendage, or the so-called sucker, has received considerable attention. The earlier writers considered it a sucker in the same sense as that found at the posterior end of a

leech, but Tonnoir [1] not finding any muscles inserted in the middle of the disc doubted its utility as a sucker. Dr. Puri [2] who has quite recently published a monograph on the structure of these larvae, has found definite muscles and has observed ' that they contract when a larva fixes itself by its posterior end.' He further points out that ' in spite of the presence of these muscles the larva cannot fix itself effectively without the further help of the sticky salivary secretion.' A very close study of the habits of these larvae enables me to say that the posterior appendage does not act as a sucker, and the larva fixes itself with the help of hooks and the salivary secretion alone. The larva spins out this salivary secretion into a fine silk thread which is very sticky and very strong. I have watched a fairly large specimen of a mayfly nymph struggling to free itself from the silk thread of a *Simulium*, and it has been observed time and again that if a larva is disturbed it lets go its hold and is carried away by the current for some distance but all the time it keeps hanging on to its support by a fine silk thread. By means of this rope-way the larva can crawl back to its former support. The consistency of this thread must be very remarkable for it can bear not only the weight of the animal when it presents an inverted stream-line form to the current (for the larva climbs with the head pointing up-stream), but also the tremendous rush of the current at one and the same time. The posterior ' sucker ' is provided with a rosette of hooks and the function of these hooks and, therefore, of the ' sucker ' is to grip firmly a cluster of silk threads which the animal secretes on the spot where it wants the posterior appendage to be fixed. The necessity for the presence of muscles in connection with this appendage is obvious, for in order to disengage the hooks from the salivary secretion a strong and sudden muscular pull is needed. The muscular action noticed by Dr. Puri at the time of the attachment of the sucker is a manipulation on the part of the animal to enable it to fix its hooks properly in the secretion.

Needham and Lloyd [3] give an interesting account of the general habit of the *Blepharocerid* larvae. They say that though ' Not the most limpet-like but yet the best adapted for hanging on to bare stones in torrents is the curious larva of the net-veined midge, *Blepharocera*, an inhabitant only of clear and rapid streams. The depressed body of this curious little animal is equipped with a row of half a dozen ventral suckers, each of which is capable of powerful and independent attachment to the stones. So important have these suckers become that the major divisions of the body conform to them and not to the original body segments. On these suckers, used as feet, the larva walks over the stones under the swiftest water, foraging in safety where no enemy may follow.' They further observe that ' the naked pupa is found in the same situation and is attached by one strongly flattened side to the

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[1] Tonnoir, *Ann Biol. Lucustre*, xi, pp. 163–172 (1923).
[2] Puri, *Parasitology, Cambridge*, xvii. pp. 311, 312 (1925).
[3] Needham and Lloyd, *Life of Inland Waters*, p. 368 (New York : 1916).

supporting surface.' These larvae are indeed the most highly specialized of all the torrent-inhabiting animals, but in a suitable habitat they are found in countless numbers. I have observed the young larvae in comparatively calm waters either at the side of

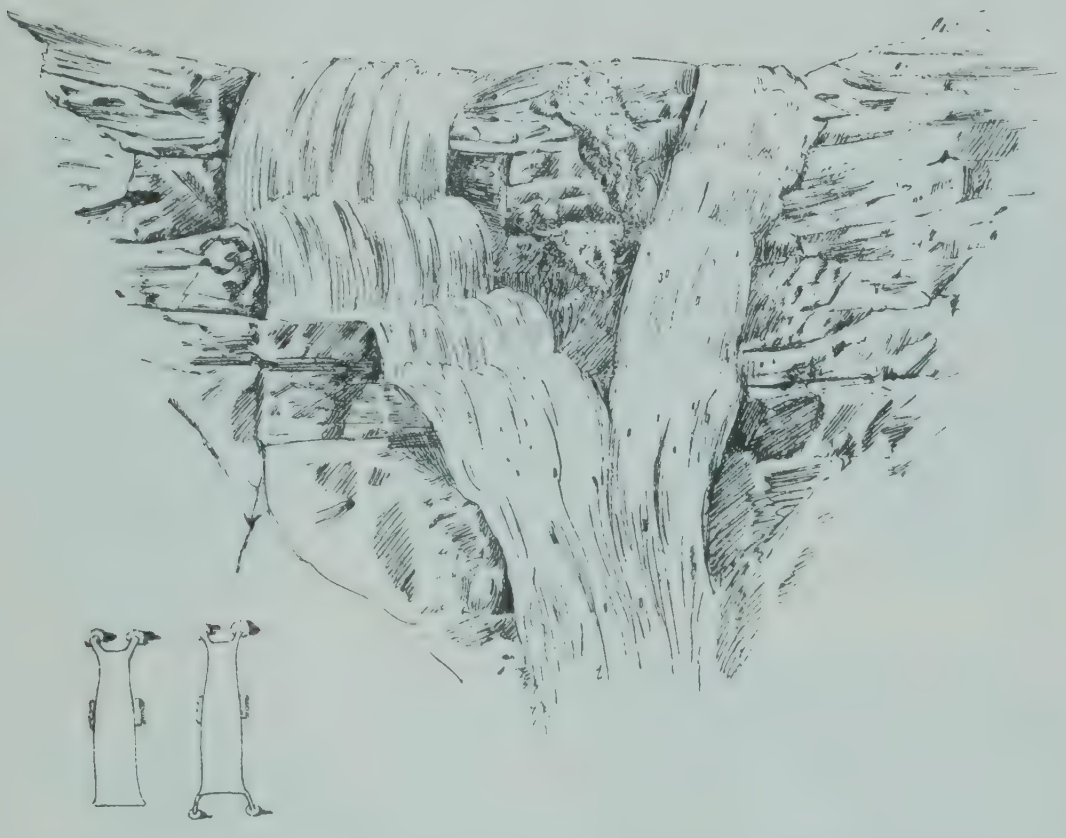


Fig. 8.—Habitat of *Blepharocerid* larvae and caddis-worms.

At the head of the waterfall a large number of larvae of the net-veined midge were found, while on the sides of rocks in the course of the fall were found caddis-worms in their peculiar cases.

the strong current or actually in places where the current does not run very fast. There appears to be a regular correlation between the stage of growth of a larva and the rapidity of the current in which it lives. The pupæ were also found along with very young larvæ or in small nooks and corners where they were comparatively safe. They usually occurred on vertical rocks over which the water fell and thus kept them moist.

Ladies and gentlemen! You must yourselves have noticed from what I have said, and from what has already been pointed out by Needham and Lloyd,[1] that ' the impress of environment is seen not only in the form of a living animal but also in that of the non-living shelter that it builds. In this there is a parallel of form in the secreted shell on the back of the snail, *Ancylus*, and in the manufactured shell of the back of the caddis-worm, *Helicopsyche*. One would have to search widely to find better examples of the effects of environment in moulding to a common form these representatives of many groups of very diverse structural types. Two of them, at least, were sufficiently like lotic mollusca to have deceived their

[1] Needham and Lloyd, *op. cit.*, p. 374 (1916).

original describers. *Psephenus* was first described as a limpet and *Helicopsyche* as a snail.'

With your permission may I avail myself of this opportunity to thank the successive Directors of the Zoological Survey of India who have given me every possible encouragement and facility to pursue the study of this subject. I am especially

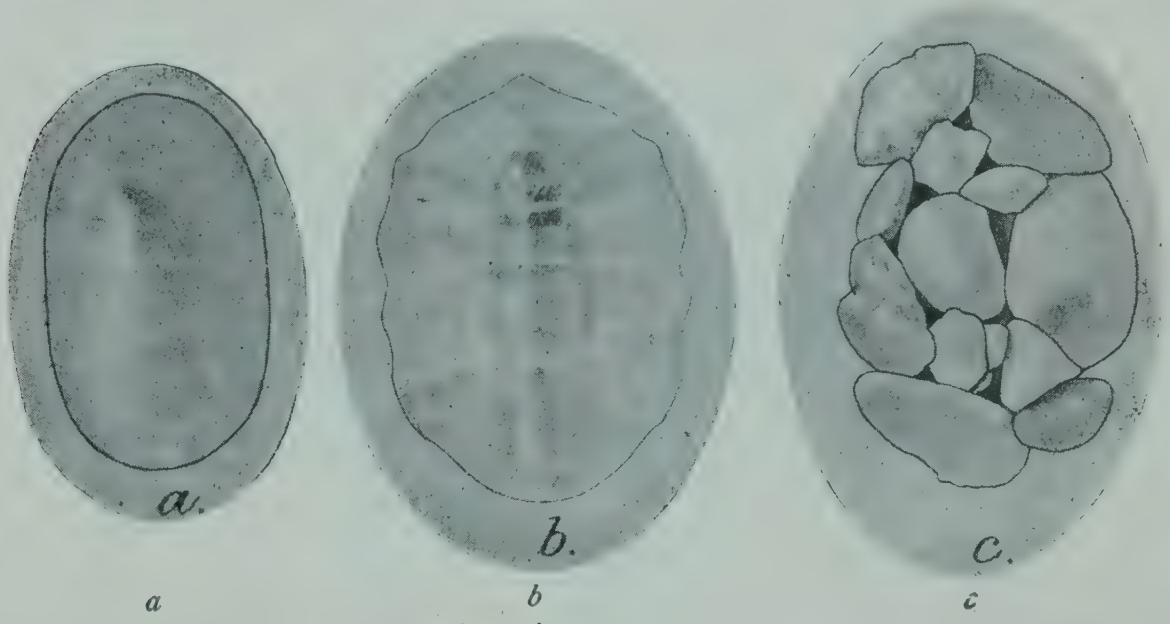


Fig. 9.—Showing impress of environment on the form of the non-living shelter.

(*a*) *Ancylus*, a snail ; (*b*) and (*c*) cases of two caddis-worms from Pashok in the Darjeeling District.

indebted to Major R. B. Seymour Sewell, who very kindly allowed me to tour in the Kangra Valley, the Khasi Hills and the Darjeeling Himalayas in the course of the last year to check my results gained from the study of the ' lotic ' fauna in previous years. It has thus been possible for me to present to you this evening fresh views on the various aspects of the life of the animals that inhabit the swift currents of our torrential streams.

Addendum

In my public lecture I had to content myself with a few typical instances illustrative of adaptations for life in rapid waters. In this note I propose to complete my account of ' Animal Life in Torrential Streams ' by citing examples from three other groups of insects whose larvae, pupae or adults frequent swift currents.

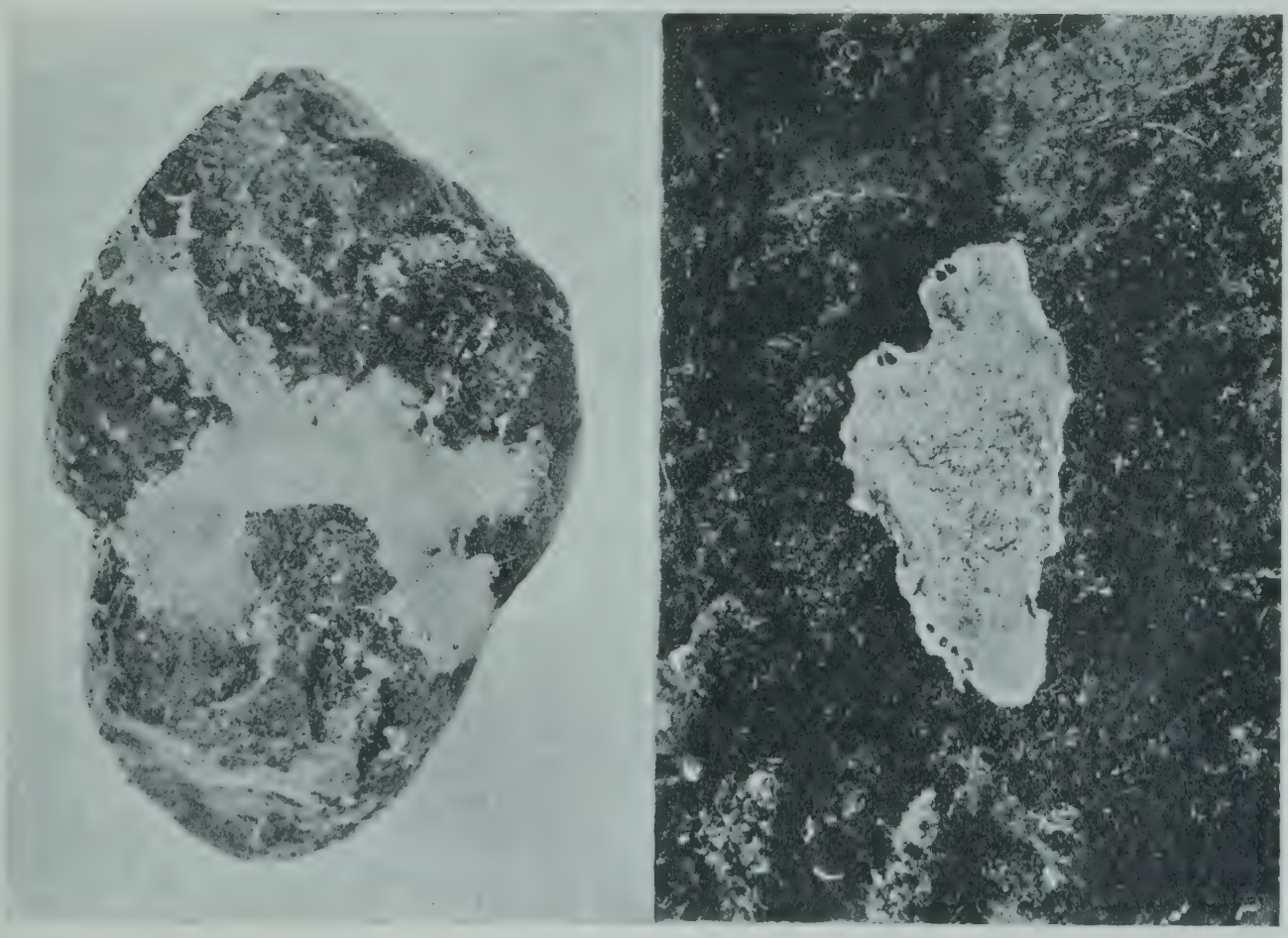
Caterpillars of certain moths of the sub-family *Hydrocampanæ* are known to lead an aquatic existence. Our familiar examples[1] of such larvae are inhabitants of sluggish or stationary waters ; they make a shelter out of the leaves on which they feed and which they fasten together by means of silk. In recent years, however, a third type of aquatic larvae has been found in rapid-running streams. In 1908, Muir and Kershaw[2] found caterpillars of *Aulacodes simplicalis*

[1] Miall, *The Natural History of Aquatic Insects*, pp. 226–235 (London) : 1895 ; Needham and Lloyd, *Life of Inland Waters*, pp. 218–220 (New York : 1916); Imms, *Text Book of Entomology*, p. 492 (1925) ; Needham in Ward and Whipples' *Fresh Water Biology*, p. 903 (New York : 1918).

[2] Muir and Kershaw, *Proc. in Trans. Ent. Soc. London*, pp. xl–xlv (1909).

Snell in a very fast current at Lappa, a mountainous island on the western side of the harbour of Macao in China, and Lloyd[1] has described larvae of *Elophila fulicalis* that live on stones in rapid streams of Ithaca, New York. I have found larvae of similar habit both in the Darjeeling Himalayas, 2 miles below Pashok, and in the head waters of the Nerbadda River. These larvae weave an irregular shelter of thin-spun silk which is attached to a piece of stone at irregular intervals leaving a series of holes for the larva to come out through for the purpose of feeding, etc. Each larva at the time of pupation manufactures a dome-shaped pupal shelter under some portion of the larval cover and this it fastens very carefully to the rock leaving rows of marginal openings on either side for free circulation of water and air through it. When the pupal case is completed the unused portion of the larval shelter is washed away. The pupal case shows a remarkable similarity to the limpet-like non-living shelters to which I have referred to already.

On reference to the Museum Collection I have found similar caterpillars collected by Dr. F. H. Gravely at Hoshangabad and Pachmarhi in the Central Provinces and provisionally referred to the genus *Aulacodes*. Dr. B. Chopra collected a number of these larvae at Kurseong in the Darjeeling Himalayas. All these are



a *b*

Fig. 10.—Larval and pupal shelters of a Pyralid moth.
(*a*) Larval shelter; (*b*) Pupal case.

[1] Lloyd, *New York Journ. Ent. Soc.*, xxii, pp. 145–152, pp. iii, iv (1914).

flattened from above downwards and are provided with branchial filaments for aquatic respiration.

Drs B. Chopra and H. S. Rao have drawn my attention to certain creeping Water-Bugs (Family *Naucoridæ*) recently collected by them in Burma from underneath stones in swift currents. These insects are flat-bodied and are oval in outline. The femora of the front legs are greatly enlarged and are fitted for grasping, while the middle and hind legs are suited for crawling about. The under surface of each half of the posterior segments is provided with a group of strong spines, which probably act as adhesive pads in the same way as the spines on the sucker of *Echeneis*.

Neuropterous larvae of various kinds are found in swift currents, but they are not by any means specially modified for such an existence. They live under stones and are not affected by the rapidity of the current. Several other kinds of beetle and dipterous larvae are found under stones and are not modified for stemming the swiftness of a current except for the fact that they possess very strong claws.

I want to express here my great indebtedness to Mr. S. Ribeiro for the valuable assistance he has rendered to me in sorting out my insect material and in looking up references for me on various points.

WILD ELEPHANTS IN THE UNITED PROVINCES

BY

F. W. CHAMPION, I.F.S.

(*With four plates*)

All along the forest belt at the base of the United Provinces' Himalayas wild elephants are to be found in small numbers and a few also occur in the terai forests of Oudh, as well as in the Zemindari forests of Bijnor and elsewhere The largest number live in the dense bamboo forests of the Garhwal Bhabar, in the Lansdowne Forest Division, where there are probably about fifty permanent residents, but elsewhere the numbers are smaller and the total head of wild elephants in the whole of the United Provinces probably does not exceed some 250 individuals, divided up into a number of small herds, with numerous semi-solitary tuskers and maknas scattered about in the forest areas. A fairly large herd has recently appeared in the terai forests of the Pilibhit Forest Division, in Oudh, and it is probable that this herd has recently emigrated into British India from the neighbouring forests of Nepal.

In the earlier part of the last century these wild elephants were greatly persecuted by sportsmen, particularly in the neighbourhood of Dehra Dun, and it is probable that they were saved from annihilation only by the Elephant Preservation Act of some fifty years ago. This Act prohibits the shooting or killing of elephants entirely, except in the case of proclaimed rogues, and it is a great pity that some of the other species, such as rhinoceros, were not saved from destruction in the same way. Elephant-catching operations have taken place a few times since elephants have been preserved, but certainly not more than 100 have been caught, whereas the number of proclaimed rogues that have been shot could not exceed twenty, yet the number of elephants at present in existence seems remarkably small after fifty years of protection, and it would appear that they are not breeding as prolifically as one would have expected under the circumstances. The number of young calves to be seen is extremely small and it has been suggested that this may be due to in-breeding as the result of segregation from the large numbers of elephants in Nepal, of which these United Provinces' elephants originally formed a part. At one time large stretches of the Nepal terai forests adjoined the forests of the United Provinces and there were then numerous opportunities for wild elephants to pass from one country to the other, but much of the Nepal elephant country has since been opened up for cultivation and few elephants now come over from Nepal to inter-breed with the survivors in the United Provinces. The new herd in Pilibhit already referred to has apparently come from Nepal, and it is to be hoped that these animals will spread over the Province and infuse new blood into what seems to be a dying race.

The ordinary wild elephant of the United Provinces appears to be a very inoffensive individual and does not ordinarily do any harm

to mankind, although he is held in terrible awe by the local inhabitants and men working in the jungles. Indeed, in Lansdowne Forest Division—the main home of the wild elephants—there has been no casualty from them for the last ten years, although one rogue killed a number of people about the beginning of the Great War, before he was finally shot by the then Divisional Forest Officer, Mr. R. St. G. Burke, within a few hundred yards of the Forest Rest House at Kotwara.

These wild elephants are, however, extremely destructive to bamboo forests and also destroy a considerable number of young sal trees, so that some Forest Officers are of the opinion that they should be caught or destroyed in the interests of Forestry. The Balrampur trackers consider that the number of animals at present in the forests is insufficient to justify the heavy expense of 'khedah' operations, and it would indeed be a pity if Government were to allow the few remaining wild elephants in Northern India to be slaughtered for the sake of the very slight increase in forest revenue which might result upon their destruction. However, one is glad to be able to write that there is no immediate prospect of such a calamity occurring.

The United Provinces' elephants do not appear to carry very large tusks and I have never seen one with tusks which I should estimate at over 50 lbs. each. There is, however, said to be one famous tusker, known locally as the 'Palak-danta,' which wanders about in the Reserved and Zemindari forests of the Bijnor District, and this animal is reported to be one of the very finest elephants in India, worth a huge sum should it ever be captured. Once or twice agitations have been made by interested people to have this animal proclaimed as a rogue, but fortunately the evidence against him is very weak, and, so far, it has been possible to protect this magnificent creature from an ignominious death at the hands of some local sportsman. I have never had the good fortune to see this beast, or try my camera on him, although I have been in his neighbourhood a number of times and still hope that we may yet meet one day.

Even though large tusks are rare in the United Provinces, the elephants often grow to a large size and two rogues have been shot within recent years measuring well over ten feet at the shoulder, the details of these two animals being recorded in the current numbers of the *Indian Forester* at the time. Of these, one was shot in the Ramnagar Forest Division in 1914 and measured 10 ft. 4 in. high, the tusks being 6 ft. 4 in. and 6 ft. 3½ in. in length and each 56 lbs. in weight. The other was much the same size and was shot at about the same time in Haldwani Forest Division.

Wild elephants make a most interesting and exciting subject for the animal-photographer and I have managed to make some 50 negatives of individual elephants during the last five years, although I have yet to succeed in making a satisfactory picture of a herd. Some of these pictures have already been reproduced in *Country Life* and elsewhere and some typical examples—which have not yet been published—are included in this article. The first picture



F. W. Champion. *Copyright.*

A YOUNG TUSKER IN WHICH THE UPPER EAR RIMS HAVE NOT YET BEGUN TO TURN OVER.



Copyright.

F. W. Champion.

AN OLD TUSKER WITH ONE TUSK BROKEN.

represents a young tusker whose ear fringe has not yet begun to turn over; the second, a middle-aged makna (tuskless male)—a fine muscular elephant; and the third, an old animal in which the ivory was worn and yellow and one of the tusks broken off in the middle. These elephants were all photographed with a reflex camera used from the back of a staunch tame female Forest Department elephant which does not exhibit the fear of wild elephants so common among tame elephants. Indeed, many tame elephants cannot be induced or driven to approach anywhere near one of their wild cousins and the mahawats are often even more afraid. It is somewhat difficult to understand why tame elephants and mahawats should be so afraid of wild elephants, which are normally not dangerous, and which have allowed me to approach within a few yards on numerous occasions without any damage resulting therefrom. True, we were once charged viciously by a 'masth' bull in charge of a herd, and on this occasion we were saved from a bad accident only by firing two barrels of a shot gun over his head, thereby causing him to swerve and rush past us at two or three yards' range; but this was an exception as the 'masth' discharge was clearly visible at some distance, and we were simply asking for trouble by attempting to photograph this particular beast. The usual semi-solitary bull will either bolt the moment one attempts to approach him on a tame elephant, or else he will stand and watch one's approach with deep interest. Indeed, he will sometimes advance towards one as one is taking photographs, and such was the case with the old tusker figured with this article, who approached so close that his whole body could not come within the field of my camera. It is somewhat nervous work taking photographs of a wild elephant—who after all is never fully to be trusted—approaching one in this way; but if one's mahawat fires a shot gun over his head whenever he comes uncomfortably close, in most cases he will retreat, or, at least, not advance any further, so that such photography provides one with a good deal of excitement without being unduly dangerous. I have not attempted to photograph wild elephants on foot, as one's view-point is so low that intervening branches and grass more often than not utterly ruin one's chances, which at all times are none too numerous owing to the bad lighting in the denser forests which the elephants frequent during the daytime. It is, however, perfectly practicable to photograph wild elephants on foot when they are bathing or drinking in open pools, but they seem to prefer the night for such operations and I have never been sufficiently fortunate as to catch one in the act in photographically-possible daylight.

Perhaps the most remarkable feature connected with wild elephants—a feature which has puzzled all who are intimately acquainted with them—is the extraordinary paucity of records of elephants which have been found dead after having died a natural death in the forests. Indeed this subject has been exploited by novelists to a considerable extent in the shape of romances dealing with the hidden stores of ivory which are supposed to exist in Africa and elsewhere as a result of the accumulations of centuries of remains of elephants which have all collected in the same place

when they felt death approaching upon them. It is said that expeditions have actually been financed in Africa with the sole object of finding these supposed treasure-troves of ivory, but none has ever been found, and the mystery still remains as to what happens to the bodies of wild elephants when they die. It is to be noted that even Mr. Marius Maxwell, whose recent splendid book *Stalking Big Game with a Camera* is practically a monograph on the African elephant, never found a dead wild elephant during his expeditions, and in his writings seems rather studiously to avoid this subject, which is of such extreme interest to all who are interested in these magnificent creatures.

I have therefore attempted to collect all records of wild elephants which have been found dead in the United Provinces forests during recent years and have tried to ascertain the cause of death in each case. The particulars of each record are as follows :—

(1) A dead middle-aged bull elephant with biggish tusks was recorded in 1921 by my brother, Mr. H. G. Champion, I.F.S., from Harai, in Haldwani Division, where it was found on a fireline about two days after death. The distance from water was about half a mile and the cause of death was uncertain, there being no sign of external injury. Some arsenic had been used in the neighbourhood for killing Rohini (*Mallotus philippinensis*) trees, but, as elephants do not eat either the leaves or bark of Rohini, it seemed unlikely that this was the cause of death.

(2) A second dead elephant, a small female, was also found some four days after death at Goria Rau in Haldwani Division the same year. It was not inspected by any officer, but it was said to show a number of wounds on the throat and neck, and may possibly have been killed by a tiger, although such an occurrence is very rare in these forests, however frequent it may be in Burma (*vide* Mr. Hopwood's recent article in the *Indian Forester*).

(3) A third case is recorded by Mr. E. A. Smythies, I.F.S., also from Haldwani Division—which, incidentally, appears to be a very fatal place for wild elephants. This animal was a fine solitary tusker with six feet tusks and was found in November 1925 by a marking gang. He had apparently died about the beginning of October in a patch of what would have been swampy ground—but not quicksand—at that time of the year. His legs were embedded in the ground about 2½ to 3 feet deep, and he was half-squatting, half-lying, on his left side. It did not appear that he had been caught in a quicksand—elephants are very clever in avoiding such danger-spots—as there was a solid bank with trees and shrubs about two yards in front of him, and he was not so deeply embedded that he could not have struggled out somehow. He was not an old or feeble elephant, and it is possible that he may have been sick at the time and thus have temporarily lacked the strength to struggle out, or he may have been bitten by a hamadryad.

None of these elephants, however, was a particularly old beast, so that the finding of their carcases does little to help towards a solution of what happens to old elephants when their time comes to depart from this world. The same remark applies to the two dead elephants recorded by Lt.-Col. Faunthorpe in his articles entitled



F. W. Champion. *Copyright.*

A LARGE MIDDLE-AGED MAKNA.



F. W. Champion.

Copyright.

A FEMALE ELEPHANT WHICH PRESUMABLY DIED OF OLD AGE.

'The Most Dangerous Sport,' which were published in the *Pioneer* during 1926; but a dead elephant has now been found in this (Lansdowne) Division which appears to be a genuine case of a wild elephant dying of old age. A photograph of the corpse is published with this article, and the case is sufficiently interesting and remarkable to justify my giving a full description of it here.

At the beginning of November, 1926, I received a report from one of my Range Officers to the effect that on October 28, 1926, a female wild elephant had died in the Zemindari Forests of the Bijnor District and that he had gone to see it on October 30, 1926. I instructed him to see that the corpse remained as intact as possible so that I could come to inspect it personally as soon as opportunity offered. This occurred on November 5, 1926, so that I saw the corpse exactly a week after death. It was lying on its side in open grass-forest containing a few scattered trees, and was only about 400 yards from the huts of some graziers, who had brought in the news of its death. Decomposition had already set in and the meat had been attacked by vultures, pigs and hyænas, but, owing to the very thick skin, they had not been able to eat very much of it. I had one shady Ber (*Zizyphus Jujuba*) tree removed and then took the accompanying photograph of it exactly as it was lying. It was a large female in a very emaciated condition, and the general appearance suggested advanced age. There was no hair on the skin, which was very light in colour, and the upper rims of the ears were very markedly turned over, although the lower fringes were not frayed. At the time of death there had not been any diarrhœa, which generally occurs with cattle disease, and there was no blood or any sign of an external wound. The graziers who found the corpse said that they had known this elephant for the last year and that she was so old and weak that she could not run away with the other wild elephants when driven from the crops of the neighbouring villagers. To prove their statement they pointed out the droppings, which contained whole leaves and pieces of grass quite undigested, this being one of the main signs of old age and failing teeth. I then had the jaws cut open with an axe and found that, in the upper jaw, only one molar remained, the grinding surface of which was worn right down to a perfectly smooth surface, whereas the molars in the lower jaw were mere stumps. Under these circumstances it is remarkable that the beast could have managed to remain alive as long as she did, and, to my mind, this appears to be a clear case of a wild elephant dying of old age in open tree forest, which it had frequented for a year or more before death. It is to be noted that, unless death overtook her suddenly, which seems unlikely under the circumstances, no attempt was made to seek seclusion in the very dense and mountainous Reserved Forests which border on the site of death.

A remarkable feature of this case is that the Ranger saw the corpse on October 30, 1926, and noted its position carefully, but when he came with me on November 5, 1926, we found that it had been moved to a different position. A dead elephant weighs something in tons, and the spot is practically uninhabited except for a few

graziers, so that I am certain that the corpse was not moved either by man or by scavenging animals such as pigs or hyænas. The graziers state that one or two other wild elephants visited the place while the corpse was lying there and it appears that they almost certainly tried to move her away or to lift her up. Wild elephants are very long-lived animals so perhaps they do not understand what death is and thus attempted to help one of their fellows in distress.

I would suggest that the tradition of wild elephants collecting in some secret place to die has little foundation in fact, and that the hidden treasure-troves of ivory exist only in imagination. Elephants live in very sparsely-populated districts in tropical forests and their life-span is very long. Deaths are therefore not common and may occur anywhere within immense tracts of forest. In tropical countries corpses are attacked by innumerable scavenging creatures such as vultures, crows, hyænas, jackals, pigs and porcupines, whose work is soon supplemented by ants, termites and fungi. Following upon these agents comes the annual monsoon, which produces in a few months, grass and other rank vegetative growth twenty or more feet high, so that a single season may easily remove the entire body and much of the skeleton of an animal even as large as an elephant. The tusks may easily be covered with vegetation and they are certainly largely gnawed by porcupines; they must also be very old, worn and broken by the time an elephant dies of old age, so that they also might easily disappear after a few year's exposure to a tropical climate and its attendent decomposing influences.

However, records of wild elephants which have died of old age are extremely scanty and one cannot argue from a particular case. Perhaps some of the numerous readers of this Journal can throw more light on this subject?

SCIENTIFIC RESULTS FROM THE MAMMAL SURVEY
No. XLVII

On the Generic Position of the Afghan Jerboa (*Alactaga indica*)

BY

Oldfield Thomas, F.R.S.

(*By kind permission of the authorities of the British Museum.*)

In his valuable Summary of the Indian Mammal Survey, Mr. Wroughton placed the Afghan Jerboa, the only Indian member of the family, in Nehring's group *Alactagulus*.[1] But this placing appears to have been done by a misunderstanding of Nehring's paper on the subject, a misunderstanding which I may have been partly responsible for, and in any case it is better to put the proper position on record for the benefit of Indian naturalists.

Nehring formed the subgenus *Alactagulus* to contain *Alactaga acontion*, contrasting the species throughout with *A. elater*, which he rightly took as representing true *Alactaga*. But it is not to *acontion* but to *A. elater* that the Afghan Jerboa is allied, indeed very closely allied, and it is certain that the two are congeneric, while *acontion* is quite a distinct animal, with a different dental formula.

In consequence the proper name of the Afghan Jerboa is, as stated by Blanford, *Alactaga indica*, Gray.

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[1] *Journal, Bombay Nat. His. Soc.*, vol. xxvi, p. 777, 1919.

NOTES ON THE BIRDS OF KASHMIR

BY

B. B. Osmaston, M.B.O.U.

Part II

(*Continued from page 999 of Volume XXXI*)

(*With a plate*)

122. Motacilla alba personata. The Masked Wagtail.

This is not a common species in Kashmir but it occurs in the valley as also in Ladakh. Females and young of Hodgson's Pied Wagtail (the common Pied Wagtail of Kashmir) are so like this species that they are very apt to be mistaken for it.

A nest of the Masked Wagtail with 4 eggs, was found by a stream at Shusha in Ladakh at 14,000′. It contained 4 eggs which resemble those of Hodgson's Pied Wagtail.

The average of 4 eggs is 20·3 by 14·5.

123. Motacilla alba hodgsoni. Hodgson's Pied Wagtail.

This is the common Pied Wagtail of Kashmir and Ladakh. It is a migratory bird, the great majority leaving Kashmir in the late autumn and returning in March. A few birds may, however, be seen occasionally near Srinagar in winter. They are very numerous throughout the main and side valleys of Kashmir proper frequenting waterways, canals, big and small streams and the margins of lakes and jhils from 5,000′ up to about 10,000′.

In Ladakh they are found on the Indus and its tributaries up to about 12,000′.

They breed in May and June, the nest being placed generally under a stone or dense low bush on a stony island or in part of the dry river or stream bed.

Five, more rarely 6 eggs are laid which resemble those of the English Pied Wagtail.

The average of 10 eggs is 21·9 by 15·6.

124. Motacilla cinerea melanope. The Grey Wagtail.

This is a common species both in Kashmir and Ladakh. They arrive in the valley in March and gradually move up to their breeding grounds up the side streams.

Nidification commences in May at altitudes of from about 8,000′ up to 13,000′ Nests are composed of dry grass and weeds lined with hair, and are placed among stones, under a stone, in a stone wall or in any pile of rubbish generally near a stream.

Five is the ordinary full complement of eggs which are freckled all over with pale yellowish or greyish-brown and which measure (average of 15 eggs) 18·2 by 14·10.

125. Motacilla citreola citreoloides. Hodgson's Yellow-headed Wagtail.

This is an exceedingly common bird in the summer both in Kashmir and in Ladakh. In Kashmir they chiefly breed in the big swamps and jhils, e. g. Hokar Sar at about 5,100′ above in sea-level. Here they are very numerous. The nests are placed on the ground in tufts of grass, a few inches above the swamp level and are well concealed. They were also found breeding at about 11,500′ in an extensive patch of swampy ground near the Gangabal Lake (Haramukh.)

On crossing the Himalayan Range into Ladakh they are found again breeding in large numbers in the Dras and Suru Valleys at from 10,000′ to 12,000′ as well as in the Indus Valley and around Shushal, etc., at 14,000′. Also at Puga in Rupshu, at 14,000′.

The breeding season is May and June in the Valley of Kashmir, June, July and August of Ladakh.

Cock birds are very striking and handsome with their lemon-yellow heads and breasts and black backs. The hen birds are found in two distinct phases of plumage.



PATH NEAR SONMARG.



A CORNER OF WULAR LAKE.



(1) Young birds, presumably one year old, where the yellow of the male bird is replaced by very pale yellow, almost white.

(2) Birds of two years and over much yellower than (1) but paler yellow than the males.

Both these varieties are found breeding. Nests are well concealed on the ground among grass, rushes, etc., often on the ' bunds ' alongside irrigation channels between cultivated fields.

Four is the ordinary full clutch of eggs but 5, 3 and 2 incubated eggs are found.

They are of a mottled pale khaki or yellow-brown with often a black streak at the broad end. Eggs from Ladakh average larger than those from the Valley of Kashmir as will be seen from the following comparative figures :—

Ladakh		*Hokra*	
Average 80 eggs.		Average 60 eggs.	
20·9.×15·1.		20·1×14·5.	
L. ...	*22·4* × 15·0	B. ...	20·6 × *15 9.*
S. ...	*17·6* × 14·1	N. ...	20·4 × *14·0.*

126. Anthus trivialis haringtoni. Witherby's Tree Pipit.

Not uncommon in the summer just above the tree limit at from 11,000′ to 12,000′ on the Kashmir side of the Himalayan Range.

A nest found on the open mountain side above Zogpal in the Lidar Valley at about 11,500′ was made of grass and lined with finer grass. It contained three fresh eggs on July 12, the average measurement of which is 19·3 by 15·2.

127. Anthus similis jerdoni. The Brown Rock Pipit.

This is a common bird in the summer months on the lower, base, rocky and stony slopes of the hills bordering the Kashmir Valley from 5,000′ to 6,000′.

They frequent rocky slopes devoid of shrubs as well as those upon which there is a certain amount of low scrub, but they never enter the forest.

They are early breeders, nests with eggs being found from April throughout May and June. Nests are composed of dry grass, lined with the same and are placed on a steepish slope under a tuft of grass or at the base of a low bush. Three or four eggs are laid which are white rather heavily marked with spots and blotches of brown, greyish-brown or reddish-brown—which measure as follows :—

L. ... *23·9* × 16·1 B. ... 23·7 × *17·6*
S ... *21·8* × 16·5 N. ... 23·6 × *16·0* } Average (24 eggs), 23·0 by 16·6.

The bird has no song, only a single note, uttered at short intervals, sometimes higher and sometimes lower in tone.

128. Anthus roseatus. Hodgson's Pipit.

This is a fairly common bird in Kashmir. In winter they are to be found in damp ground in the Valley of Kashmir and in summer on the open grassy slopes on the Himalayas and Pir Panjal Range at from 10,000′ to 13,000′ above the tree limit, and here they breed in June. A nest found above Liddarwat in the Lidar valley at 10,500′ was placed under a small tuft of grass on a steep grassy slope. It was composed of dry grass, lined with the same material, and contained 4 fresh eggs very handsomely marked with dark purplish-brown.

They measure (average) 21·8 by 16·0.

129. Otocorys alpestris longirostris. The Long-billed Horned Lark.

This large, handsome lark is common in summer at high altitudes on both sides of the Himalayan Range but especially so on the Ladakh side, and less common on the Pir Panjal Range. They occur chiefly between 11,500′ and 13,500′, on open dry sandy hillsides with scattered tufts of grass and herbacious plants, especially where there is much artemisia.

The male bird has a short rather loud and sweet song of a few notes uttered from a fixed perch generally from the top of a rock. These birds do not ever soar in the air like the skylark.

Nests are placed in a small depression in the ground scraped out by the parent bird, which is placed under the shelter of a tiny *Artemisia* or other small herbacious plant. The nest is composed of a few bits from of dry neatly lined with very fine cottony down from the *Artemisia* plant.

Three or 2 eggs only are laid, which resemble generally those of the skylark but are larger. They measure :—

L. ... *27·5* × 17·6 B. ... 27·5 × *17·6* } Average (11 eggs), 24·5 ×
S. ... *23·0* × 16·9 N. ... 23·0 × *16·9* } 17·4.

130. Otocorys alpestris elwesi. Elwes' Horned Lark.

This species is common throughout Ladakh at high elevations, from 13,000′ to 17,000′, except in Western Ladakh, on the slopes of the Himalayas, where it is replaced by the preceding species. They prefer stony, sandy ground, especially where there is a sprinkling of weeds or grass, and they are specially fond of localities where *Artemisia* is found.

The male has a short, rather shrill, song of a few notes, uttered from the top of a rock or stone, which somewhat resembles the song of the corn-bunting.

Nidification commences early in June, and 2 more rarely 3 and sometimes only one, eggs are laid. Nests are placed in small circular depressions scratched in the ground, often in the shelter of a small plant or stone and are lined with soft vegetable down.

The eggs are more or less densely mottled all over with yellowish or greyish-brown with a darker cap or zone at the broad end.

Eggs give the following measurements :—

L., from 26·1 to 21·6. B., from 17·4 to 16·2. Average (24 eggs), 24·4 by 16·9.

131. Alauda gulgula guttata. The Small Kashmir Skylark.

This is a very common bird in Ladakh in the Indus and Nubra Valleys as well as in the Dras and Suru Valleys. They arrive in Ladakh in the end of April and are found wherever there is permanent cultivation between 10,000′ and 12,000′. They frequent the barley, lucerne and grass meadows. The song of the male resembles that of the English skylark and it is uttered while soaring, as well as from a fixed perch on a bush or rock. They may often be heard singing before sunrise, but chiefly a little later in the day. Breeding commences in the end of May and fresh eggs are obtainable throughout June and July.

Nests are placed on the ground in a slight depression among grass, lucerne or young barley. Four is the usual full complement of eggs laid, but sometimes 3 only, and more rarely 5 are found.

Eggs resemble those of the English skylark in colour. They measure :—

L. ... *25·6* × 17·1 B. ... 25·6 × *17·1* } Average (41 eggs), 23·1 by
S. ... *21·1* × 15·5 N. ... 22·1 × *15·3* } 16·3.

A very similar skylark, which appears to be the same sub-species, is found breeding in the Kashmir Valley at 5,200′.

The eggs of this bird are similar, but smaller on the average as is shown by the following measurements :—

L. ... *24·4* × 16·4 B. ... 20·9 × *17·1* } Average (15 eggs), 21·5
S. ... *20·2* × 17·1 N. ... 21·1 × *15·7* } by 16·5.

132. Calandrella acutirostris tibetana. Brook's Short-toed Lark.

This is an exceedingly common bird throughout Ladakh being found almost everywhere from 10,500′ to 16,000′, except on steep ground. They are also found in the Dras and Suru Valleys, where however they are not so common. They affect sandy plains and gentle hill slopes dotted with stones and small rocks and with here and there scanty herbacious vegetation. The song, emitted from the top of a rock or stone, is poor and monotonous.

The nesting season commences in the end of May and fresh eggs may be found throughout June and the first half of July. Nests occupy slight depressions in the ground scantily lined with a little dry grass and finished with a dense, warm lining of very fine vegetable down. They are placed in the shelter of a stone or small plant, more rarely quite exposed.

Three eggs is the full clutch, but not infrequently 2 only are laid. They are rather elongate ovals, spotted all over with pale greyish or yellowish brown, occasionally in a zone at the broad end.

They measure :—

L. ... *23·0* × 14·0 B. ... 22·0 × *15·6* } Average (49 eggs), 21·0 by
S. ... *19·4* × 15·1 N. ... 23·0 × *14·0* } 14·6.

133. Zosterops palpebrosa elwesi. The Western White-eye.

This is not a very common bird in Kashmir, but it is found occasionally in the valley and on the lower wooded slopes of the hills up to about 6,000′, where it breeds. It is also occasionally seen in the spring and autumn in Srinagar. It is probably common on the lower south-west slopes of the Pir Panjal, in Jummoo and Punch.

134. Picus squamatus squamatus. The Scaly-bellied Green Woodpecker.

Occurs in Kashmir, in wooded areas up to about 8,000′ altitude, but is not very common. In winter they descend to the lower hills and valleys and may sometimes be seen in and near Srinagar.

135. Dryobates himalayensis. The Western Himalayan Pied Woodpecker.

Common in well-wooded areas on the slopes of the main and side valleys and hills generally up to about 9,000′. They are found both in fir and in mixed forest. They are early breeders.

Two nests, each containing 4 fresh eggs, were found in the Sind Valley in the third week of April in holes in willow trees about 12 from the ground. Eggs glossy, and of course pure white. They measure :—

L. and B. ... 28·0 × 19·9 } Average of 8 eggs, 26·5 by 19·1.
S. and N. ... 24·5 × 18·1 }

136. Dryobates auriceps. The Brown-fronted Pied Woodpecker.

Occurs on the lower wooded slopes in the main valley, but is not common.

137. Iynx torquilla japonica. The Kashmir Wryneck.

This is a common bird in Kashmir in the summer, especially in and around Srinagar. They are most numerous in the willow copses in the main valley, but they ascend the valleys and hills up to 11,000′. A bird was heard calling at Kargil 9,000′, but they are very rare in Ladakh.

They arrive in the last week of March and are very noisy, calling throughout April and May. Their call is identical with that of the European Wryneck.

Breeding commences in the middle of May, eggs being laid in holes in trees, chiefly in rotten portions of willow trees, excavated by the parent birds. The eggs are laid on the bare wood, or on a layer of fine chips.

Two nests found on May 23 and 24, contained 6 and 7 nearly fresh eggs respectively, pure white with slight gloss.

They measure :—

L. ... *22·1* × 14·9 B. ... 21·0 × *16·1* } Average of 13 eggs,
S. ... *20·7* × 15·9 N. ... 20·6 × *14·9* } 21·1 by 15·5.

138. Coracias garulla semenowi. The Kashmir Roller.

A fairly common bird in the valley of Kashmir and in the side valleys up to about 6,500′. They arrive in the spring and leave again, in the autumn, generally in October. In their habits they resemble the Indian roller and are often to be seen perched on the telegraph wires or on the dead branch of a tree from which they have a commanding and uniterrupted view of their surroundings.

Breeding commences in June, a hole in a steep bank, often the river bank, or in a hollow tree being selected as a nesting site.

Five or 6 eggs are laid, pure white and rather elongate ovals, with considerable gloss. The eggs are not infrequently speckled all over with small dark brown spots, which are readily removed by washing. The origin of these spots is not known but exactly similar spotting has been observed in the case of the eggs of *Ceryle rudis* and *Melittophagus erythrocephalus* in other parts of India.

Eggs' measurements are as follows :—

L. ... *39·1* × 27·6 B. ... 36·1 × *29·9* } Average (16 eggs),, 36·3
S. ... *34·2* × 29·4 N. ... 36·7 × *27·4* } by 29·0.

139. Merops apiaster. The European Bee-eater.

This is a common bird in the main valley of Kashmir and for a short distance only up the larger side valleys during the summer months. They arrive in the end of April or early in May and leave in the end of August or early in

September. They frequent the foothills and the lower slopes of the Takht-i-Suleiman, especially wherever there are soft alluvial banks or cliff. Breeding commences early in June and the birds usually nest in small scattered communities. For the reception of the eggs a hole about 2 inches in diameter is excavated in moderately soft alluvium or clay-loam. The hole slopes gently upwards for a distance of about 3 ft. at the end of which there is a spacious egg-chamber 9 inches or so in diameter, which is unlined.

Five or six rather spherical, glossy, white eggs are laid which measure as follows :—

L. ... *28·1* × 21·1 B. ... 26·9 × *22·2* } Average, (23 eggs) 25·8 by
S. ... *25·2* × 21·1 N. ... 28·1 × *21·1* } 21·9.

140. Ceryle rudis leucomelanura. The Indian Pied Kingfisher.

A fairly common bird in the main valley of Kashmir, along streams and the borders of lakes, e.g. the Wular, Dal and Anchar Lakes. This is a resident species, and an early breeder, fresh eggs having been observed on March 1, while snow was still lying about.

Nest holes are excavated in steep banks often but not always near streams. The hole is about 3′ long and the nest cavity contains as a rule a layer of fine fish bones, doubtless thrown up in ' castings ' by the parent birds.

Five or 6 eggs are laid, not very spherical, nor very glossy. They are, of-course, pure white and measure :—

L. ... *32·8* × 22·9
S. and B.... *28·2* × *22·45* N. ... 30·8 × *22·4* } Average (15 eggs), 3·03 by 23·6.

141. Ceryle lugubris guttulata. The Himalayan Pied Kingfisher.

This is rather a rare bird in Kashmir, being only occasionally met with along the larger rivers and side streams, up to about 6,000′ altitude.

This handsome bird, the largest of all the Indian Kingfishers, would undoubtedly be commoner in Kashmir if it were not for the ruthless persecution they are subjected to in the interests of fish preservation.

They are early breeders, nesting in holes excavated in the banks of streams and rivers. Unlike the preceding species they never hover in the air but dive after fish from a fixed perch.

142. Alcedo atthis pallasii. The Central Asian Kingfisher.

This is an extremely common bird throughout the Valley of Kashmir being found along every river, stream and water course as well as along the borders of the lakes and in the larger jhils. They are resident birds but they do not appear to be so numerous in the winter, so possibly some birds move down to more congenial altitudes in the frosty weather. They are found up the side valleys to about 7,000′ elevations, rarely higher but a single bird was seen near Dras (Ladakh) on May 2, at 10,500′ and a second bird above Leh at 12,000′ towards the end of May. With these exceptions the species was not met with in Ladakh.

Breeding in Kashmir commences in April and fresh eggs may be found till the end of May. From 5 to 7 glossy, rather spherical, pure white eggs are laid measuring :—

L. ... *22·1* × 17·9 B. ... 20·2 × *18·2* } Average (37 eggs), 21·2 by
S. ... *20·2* × 18·2 N. ... 20·7 × *17·0* } 17·6.

Nest holes are excavated in clay or alluvial banks, sometimes close to water, but not infrequently at a considerable distance away, nests having been observed on the slopes of the Takht-i-Suleiman, at least a quarter of a mile from the Dal Lake 200′ to 300′ above the level of the same. This beautiful little Kingfisher is very tame and confiding in Kashmir, perching on the house boats and other river craft in complete disregard of its human occupants, and it would be a good deal commoner than it is were it not that large numbers are destroyed annually by the staff of the Fishery Department.

Such slaughter is to be deprecated, in that it is improbable that this Kingfisher, even if unchecked, would perceptibly affect the stock of trout, and the bird is undoubtedly a great asset to scenery of lake and stream in Kashmir, and one probably more generally appreciated than the fish.

143. Upupa epops epops. The European Hoopoe.

This is a very common bird in the Valley of Kashmir, especially in and around Srinagar. It is also found up the larger side valleys, where it may be

seen occasionally as high as 9,000′ or even higher. It is also found, though much less common, in Ladakh, especially near irrigated land and about villages and in Leh, up to about 12,000′. It is probably commoner in Kashmir than anywhere, certainly than anywhere in the east, an abundance of food being everywhere and always available in the ever-moist grassy meadows and gardens.

They feed largely in Kashmir on the grubs of Cockchafers which they dig up in the grass lands, but they are often robbed of their prey as soon as they have obtained it, by the cheeky and ubiquitous Sparrow.

The majority arrive in March and leave in September, but a few birds may be seen occasionally even in winter. Breeding commences in April, 6 or 7 eggs being laid on the ground with no nest, sometimes in a hole in a mud wall, often in a stone wall, and less frequently in a hole in a hollow tree.

More than once eggs have been found laid on the floor of a large dark ' godown ' to which the bird has found access through some small hole.

The eggs are pale skim-milk blue when quite fresh, but they become rapidly discoloured even after 24 hours, and they are then a dull pale dirty greenish-grey.

They measure :—

L. ... *27·2* × 17·5 B. ... 25·5 × *18·6* } Average (26 eggs), 26·2 by
S. ... *24·6* × 16·7 N. ... 25·4 × *16·7* } 17·6.

144. Micropus melba melba. The Alpine Swift.

Not common, but occasionally seen at high elevations in flight.

145. Micropus apus pekinensis. The Eastern Swift.

Not uncommon between 9,000′ and 12,000′, both in Kashmir and in Ladakh, breeding in precipitous rocky ground.

Many were observed in the last week in May in the Indus Valley near Leh at 10,500′, hawking flies. They had probably only just arrived. Later they were noticed in the Shyok Valley at 10,500′ in July and below Khardong, near Kharchar, they were breeding in cliffs at 11,000′. They also breed in the crags above Sonamarg (10,000′) and near, Tosha Mundan (in the Pir Panjal) at 10,500′.

146. Micropus pacificus leuconyx. Blyth's White-rumped Swift.

Occasionally seen on the wing at higher elevations on the great Himalayan Range.

147. Micropus affinis galilegensis. The Kashmir House-Swift.

Fairly common in and around Srinagar.

148. Cuculus canorus telephonus. The Asiatic Cuckoo.

This is by far the commonest cuckoo found in Kashmir. They arrive towards the middle of April and leave during September. They are found throughout the summer, in fairly large numbers, on the Pir Panjal, as well as on the Himalayan range, alike in the valleys and on the higher hills. They breed during May, June and July from about 6,000′ up to 13,000′.

At the lower elevations they chiefly parasitize the Indian Bush-Chat (*Saxicola torquata indica*) and at higher levels, the Himalayan Ruby-throat (*Calliope pectoralis pectoralis*) the Redstarts (both *Phœnicurus frontalis* and *Phœnicurus ochrurus phœnicuroides*) and Hodgson's Pipit (*Anthus roseatus*). In Ladakh they are very scarce except in the western portion i.e., in the Dras and Suru Valleys and slopes of the great Himalayan divide, where they are common from 10,000′ to 13,000′. Their call which exactly resembles that of the European cuckoo, is heard throughout May and June and even as late as July 24.

An egg obtained on ? July, in the Lidar Valley at 7,000′ elevation in the nest of the Indian Bush Chat was white with rusty spots. It measured 24·0 × 17·4.

A second egg, from the nest of *Calliope pectoralis* was found on July 26, at the head of the Wardwan Valley below the Bhotkhol Glacier at 11,000′. It was of a uniform blue, and measured 25·4 by 19·5.

149. Cuculus optatus. The Himalayan Cuckoo.

This cuckoo, so common in Garhwal and Kumaon is relatively scarce in Kashmir. Its characteristic note—Hoo-Hoo-Hoo-Hoo—resembling somewhat the call of the Hoopoe—was heard occasionally below Gulmarg and in the Lidar Valley in June, at about 8,000′.

150. Cuculus poliocephalus poliocephalus. The Small Cuckoo.

This species is decidedly commoner than the last being found from about 8,000′ up to 12,000′, on all the higher ranges including the Pir Panjal, but chiefly at about 10,000′ to 11,000′.

The call of this Cuckoo is peculiar and unmistakeable. It consists of a rather unmusical cackling call of from 4 to 6 notes, first 4, then 5 and then 6 the call of 6 notes being repeated several times in a gradually descending scales I agree with Colonel MacGrath that the call of the bird resembles the syllables ' That's your smoky pepper.'

This cuckoo lays two distinct kinds of eggs, viz. (*a*) pure white and (*b*) uniform chocolate pink one would expect to find the latter type of egg laid in the nest of *Horornis*, but although I have found many nests of this bird in Kashmir in localities where this cuckoo was in evidence I was never fortunate enough to discover its egg.

In the Darjiling District several eggs the chocolate pink type were found in nests of the Short-wing (*Heteroxenicus*) and again in Garhwal in the nest of *Pnœpyga squamata* ; in both cases in company with *white* eggs.

151. Clamator jacobinus. The Pied Crested Cuckoo.

I was surprised to find this species, so characteristic of the plains of India, as a summer visitor to the Valley of Kashmir. They are local and not common. I found them frequenting the lower bush-covered slopes of the hills near Srinagar between 5,000′ and 6,500′.

In the plains of India they parasitize chiefly the common Babbler, *Argya caudata*, but this bird is not found in the Valley of Kashmir.

It is most probable that in Kashmir this cuckoo lays in the nest of the Streaked Laughing-thrush (*Trochalopterum lineatum*) which is common in the jungle frequented by this cuckoo.

152. Penthoceryx sonneratii sonneratii. The Bay Banded Cuckoo.

I never personally met with this bird in Kashmir but Mr. S. L. Whymper obtained one in the Lidar Valley in July 1905.

It must, I think, be a rare bird in Kashmir.

153. Psittacula schisticeps schisticeps. The Slaty-headed Paroquet.

Fairly common in the lower mixed forests of the main and side Valleys up to about 6,500′, and occasionally higher.

154. Tyto alba javanica. The Indian Barn Owl.

Not uncommon in the vicinity of Srinagar where it may be heard calling a night.

155. Strix aluco biddulphi. Scully's Wood Owl.

This Owl is common in Kashmir in all wooded areas from the level of the main valley (5,100′) up to the tree limit at 11,000′. It also occurs in Srinagar and a specimen was obtained in the winter in Peshawar.

They are nocturnal in their habits, and, when discovered, are mobbed in the day time by crows and other small birds. One was seen near Srinagar being chased and eventually killed, by a pair of Hawk Eagles. The ordinary call of this Owl is a loud Hoo.....Hoo.....Hoo-oo-oo-oo. With an interval of some four seconds between the first and the second Hoo, and about half a second between the second Hoo and the final rolling note a loud ' Quack ' is also sometimes heard as well as a soft ' coo ' very similar to the call of the Ring Dove.

156. Bubo bubo bengalensis. The Rock Horned Owl.

Fairly common on the lower rocky hillsides on all sides of the main Kashmir Valley between 5,000′ and 6,000′. A couple of pairs are resident on the

Takht-i-Suleiman near Srinagar. These birds are not very nocturnal and they may often be seen in the mornings or evenings perched on a rock on precipitous hillside, but they avoid direct sunlight.

They feed almost entirely on rats, with an occasional Musk Shrew, as may by seen from their castings. The call, heard in the dusk before dawn or after sunset, is a loud *Hoo* (a single, not a double note.)

Nidification commences in March, three eggs being laid in sheltered holes or small caves among rocks on steep, almost percipitous, rocky hillsides. On one occasion a jungle crow was observed in close proximity to a nest containing three fresh eggs. On being scared away it was found that he had just broken into one of the three eggs, all of which would doubtless have been sucked in due course.

The eggs are large broad ovals without gloss measuring :—

L. and B. ... 61·3 × 47·7
S. and N. ... 58·7 × 46·4
} Average (6 eggs), 60·1 by 47·3.

157. Bubo bubo. (? subsp.)

A large Horned Owl was observed on three occasions in Ladakh.

(1) In the ruins of the Lamasery at Basgu (Indus Valley) at 10,000′.
(2) On the rocks above Puga (Rupshu) at 14,000′.
(3) On the Lamasery Hill at Nimu Mud (Indus Valley) at 13,500′

They undoubtedly breed in all these three localities.

158. Glaucidium cuculoides cuculoides. The Large Barred Owlet.

A pair were seen in the olive grove near Garhi (elevation 3,000′) on the Jhelum Valley road.

159. Glaucidium brodiei. The Collared Pigmy Owlet.

This Owlet, so common in the upper hill forests in Garhwal and Kumaon, from 8,000′-9,000′ is decidedly rare in the Kashmir. It was heard calling on 2 or 3 occasions only below Gulmarg on the Pir Panjal Range. The call is a clear bell-like whistle repeated four times, with a short pause between the first and second and again between the third and fourth notes thus :

Hoo—Hoo-Hoo-Hoo.

160. Pandion haliaetus haliaetus. The Osprey.

Not infrequently seen on the Wular Lake and along the Jhelum River as far up as Srinagar. They are chiefly seen in the cold weather months but a pair were seen as late as April 24, and the birds are reported to have bred in the neighbourhood of the Lake.

161. Ægypius monachus. The Cinereous Vulture.

This bird is rarely seen in Kashmir.

162. Gyps himalayensis. The Himalayan Griffon.

Common in Kashmir from the level of the valley up to at least 12,000′.

As many as fifty were counted round the carcase of a buffalo at 10,000′ in the Lidar Valley. They are much less common in Ladakh but a few were seen in May near Dras. They breed on rocky precipices from 6,000′ to 8,000′ nests being usually inaccessible without ropes.

Two nests were obtained on February 11 and 15, at 6,500′ while snow was still on the ground. They contained one fresh egg each, spotless white, which measure 96·0 × 69·0 and 88·4 × 69·7 respectively.

163. Neophron percnopterus percnopterus. The Egyptian Vulture.

Not common in Kashmir, but is found generally distributed in the valley. Two pairs breed on preciptous ground on the Takht, Srinagar, at 5,500′.

These birds appear to be summer visitors only, presumably retiring to the plains in winter.

Two eggs are laid in a nest composed of sticks and lined with dead leaves, rags, paper, etc. They are white richly marked with deep reddish brown They measure (average of 6 eggs) 66·4 by 51·8.

Fresh eggs are obtainable about the middle of April.

164. Gypaëtus barbatus grandis. The Eastern Bearded Vulture.

This great bird is found commonly in Kashmir on all the hills surrounding the valley from about 6,000′ upto 13,000′ and also in Ladakh, where however it is rare. They are usually to be seen quartering the open hillside on motionless wings, only rarely having recourse to a few measured wing-flaps.

They may frequently be observed to rise upwards of a thousand feet in a few minutes in big circles, without a single stroke of the wing evidently taking advantage of rising currents of air.

They feed on carrion, including bones, and have never been observed by the writer attacking or threatening a living animal.

165. Aquila nipalensis nipalensis. The Eastern Steppe Eagle.

Occasionally seen in the vicinity of Srinagar and elsewhere in the Valley in the winter months.

166. Hieraëtus fasciatus. Bonelli's Eagle.

Not common but occasionally seen singly or in pairs in the main and side Valleys of Kashmir below 7,000′.

167. Hieraëtus pennatus. The Booted Eagle.

Not uncommon in the Valley of Kashmir where they breed in May. At least two pairs breed near the tops of very big chenar trees in Srinagar and they are responsible for most of the thefts of domestic fowls, attributed to the black-eared kite.

A single egg, obtained on May 15, was pure white, fresh, and measured 51·7 by 41·9.

168. Cuncuma leucorypha. Pallas' Fishing Eagle.

A fairly common bird in the vicinity of lakes and jhils in the main valley of Kashmir, where they are resident, nesting in early spring or late winter on the summits of huge chenar trees.

They also occur in Ladakh, a pair having been seen at 10,600′ in the Indus Valley and another pair near the Tso Moriri Lake at 15,000′ in Rupshu. This was in June. Col. Meinertzhagen informs me that he found a pair ensconced near the jhil at Shushal (14,200′) which had killed off practically all the young geese (*Anser indicus*) on the water.

169. Milvus migrans lineatus. The Black-eared Kite.

This is the common kite of Kashmir. It is found throughout the main valley, and is specially numerous in and around Srinagar. They are also seen on the surrounding mountains up to at least 11,000′, but they probably all breed in the valley between 5,000′ and 6,000′.

A few were seen also in Ladakh, especially near Leh, where they also breed.

This kite is resident in Kashmir throughout the year. Breeding commences about the middle of March. Nests are usually placed high up in a fork of a big chenar tree, from 50′ to 100′ from the ground and are generally difficult to reach. They are occasionally also built in poplars and large mulberry trees and are there more easily accessible.

The nest is a large mass of sticks, lined with wool, hair, rags, paper, etc. Two eggs—more rarely 3—are laid which resemble those of the common pariah kite, but are larger on the average. The ground colour is white, and the eggs are blotched, spotted or sometimes lined in various degrees, with chestnut brown.

They measure :—

L. *61·8* × 42·4 B. 59·7 × *47·4*
S. and N. *53·4* × *41·7*
} Average of 59 eggs, 57·9 by 45·3.

The average of 47 eggs of *M. migrans govinda* taken in Rawalpindi is 52·4 by 43·0.

170. Circus macrourus. The Pale Harrier.

171. Circus cyaneus. The Hen Harrier.

Both the above species may often be seen during the autumn winter and early spring months quartering the ground in the valley.

172. Circus æruginosus æruginosus. The Marsh Harrier.

This is a common bird in all the jhils and marshes in the Valley of Kashmir. They arrive as a rule early in September and leave again in April or May, but occasionally a bird may be seen in summer and it is probable that rarely a few stop and breed in the valley.

173. Buteo ferox. The Long-legged Buzzard.

This bird is not rare at high elevations on the Himalayan and Pir Panjal Ranges, on both sides of the valley. They are usually found near the upper limit of the forest or well above it up to about 13,000′.

They usually place their nests in precipitous rocky ground.

They feed to a large extent on small voles. The cry is a loud ' mewing ' call.

174. Accipiter nisus melanochistus. The Indian Sparrow Hawk.

This hawk is not uncommon in Kashmir at all elevations up to about 11,000′. A pair was also observed at Khalatze on the Indus, at 9,500′ in Ladakh. They breed in Kashmir.

175. Falco peregrinus calidus. The Siberian Peregrine.

Occasionally seen in Kashmir in the cold weather. A single bird was seen in the Indus Valley, Ladakh at 13,500′. It had captured a chough. This was early in July.

176. Falco subbuteo subbuteo. The European Hobby.

With the exception of the Kestrel this is the commonest falcon occurring in Kashmir. It is found in the main valley as well as on the hills and mountains, and on rocky mountain sides as well as in rather open forest. It is also found in Ladakh where it is not rare.

July is the month when nidification takes place. The nest is placed fairly high up in a tree. A nest found in the Indus Valley at 10,500′ above Chushot was in a poplar grove. The nest was incomplete in June. A second nest at Kargil 9,000′ in Ladakh was also in a poplar tree, in the nest of a carrion crow from which I had previously (in May) removed the eggs. On August 4, it contained three young in down. A third nest was half-way up a spruce fir standing on an island in the Lidar River near Pahlgam at 7,000′. It contained 3 fresh eggs on August which resemble kestrel eggs in colour. A fourth nest was at the top of a silver fir in Gulmarg, in July. The average measurement of 3 eggs is 39·5 by 31·5.

177. Falco tinnunculus. The Kestrel.

A kestrel, possibly the Indian Kestrel, is common throughout Kashmir at all elevations from 3,000′ up to at least 14,000′.

They breed on rocky cliffs.

A kestrel, possibly the same species, is found throughout Ladakh up to 16,000′. They are common in Leh where they build in poplar trees. Two nests taken in the first week of June contained 4 fresh eggs in each, rather paler in marking than those of the European kestrel.

They vary in length from 41·2 to 38·7 and in breadth from 33·8 to 30. The average of 7 eggs being 40·0 by 32·3.

178. Columba livia intermedia. The Indian Blue Rock Pigeon.

Common in the Kashmir Valley, as well as in the lower and upper hills, up to about 9,000′. They are chiefly found on the lower rocky hills, where they breed from May to August. Their eggs average about 39·8 by 28·0.

179. Columba livia neglecta. Hume's Blue Rock Pigeon.

Common in Ladakh, in the Indus, Shyok and their side valleys up to about 11,000′ They are chiefly to be seen in and around cultivation, where they often associate in large flocks, mixed with the blue hill pigeon and occasionally also with the snow pigeon.

They breed in rocks and ruined buildings. A nest in the Basgu ruined Fort in the Indus Valley at 10,500′. Contained a single fresh egg on May 11 and another single egg in the same nest on July 23.

These eggs averaged 40·6 by 28·5.

180. Columba rupestris turkestanica. The Indian Blue Hill Pigeon.

This is the high-level pigeon found throughout Ladakh, including the Dras and Suru Valleys at elevations of from 10,000′ to 16,000′. They frequent rocky, precipitous ground, but often come down to feed in the fields or among stony ground by streams. They were observed drinking the brackish water of the Tsomoriri Lake.

They breed in holes in rocky cliffs, caves, etc., and several old nests were seen near the Tsomoriri and Tsokar Lakes in Rupshu at 15,500′. These nests were solitary, and fairly easily accessible. They are probably rather late breeders, as no eggs were seen in June.

181. Columba leuconota leuconota. The Snow Pigeon.

This is a common bird in the higher hills and valleys of Kashmir, being found to a less extent in the eastern slopes of the Himalayas, towards Ladakh, at the head of the Dras and Suru Valleys. They are generally to be seen in small flocks feeding on the grassy slopes, among rocks below the snow-line.

They breed in rocky precipices, often near rivers and streams between about 10,000′ and 13,000′.

182. Streptopelia orientalis meena. The Himalayan Turtle Dove.

This is a common species in the well-wooded areas on the slopes of the mountains throughout Kashmir, chiefly between 6,000′ and 10,000′ a few are also to be seen on the Ladakh side of the Himalayan Range in the Indus Valley as well as in the Suru and Dras Valleys, where they also breed.

The breeding season is from May to August. Nests are built in small trees or dense bushes in forest generally at no great height from the ground.

Eggs average 32·3 by 24·0.

183. Streptopelia decaocto decaocto. The Indian Ring Dove.

Very numerous in the Valley of Kashmir being found also up the side valleys to about 6,500′ only. This species is not found in Ladakh, except on migration. A party of about 10 birds was seen at Dras 10,000′ on May 2, but they move evidently only on passage.

They breed in the Valley at 5,000′ in May and June, the nests bieng placed in small trees or large bushes.

The eggs average 30·2 by 23·4.

184. Syrrhaptes tibetanus. The Tibetan Sand Grouse.

This species is found in the stony sandy desert areas in the higher parts of Ladakh. They were met with by the writer only in Rupshu near the Tsomoriri Lake where a pair of freshly hatched chicks in down were found on June 18.

About 10 pairs of these birds frequented the stony level plain at the south end of the lake, but no eggs were discovered.

185. Catreus wallichii. The Cheer Pheasant.

This is rather a local bird in Kashmir, not being found in the main Valley, but is believed to be not uncommon towards the Kishenganga and on the outer slopes of the Pir Panjal Range.

186. Lophophorus impejanus. The Monal.

This handsome pheasant is found generally distributed on the mountains surrounding the Kashmir Valley, in summer between 8,000′ and 11,000′. They are not common, except in the less frequented parts, e.g., the Kishanganga Valley, the Wardwan Valley, etc.

Young just able to fly were seen with their parents above Battal (9,000′) in the Sind Valley on June 29.

187. Pucrasia macrolopha biddulphi. The Kashmir Koklas.

Generally distributed but not very numerous in the big fir forests of northern Kashmir. They are chiefly found between 7,000′ and 10,000′. The ‘crow’ of the male bird is similar to that of the common koklas. This latter bird is said to be found in South Kashmir.

188. Gennæus hamiltonii. The White-crested Kalij.

This pheasant is not found in the main valley of Kashmir nor on the surrounding hills. It occurs however in South Kashmir and on the outer lower slopes of the Pir Panjal.

189. Alectoris græca chukar. The Chukor.

Extremely common on the lower slopes of the hills bordering on the main valley, and found up to at least 11,000′. They afford excellent shooting in the cold weather months.

Breeding commences early in April. About 12 or 13 eggs are usually laid under a rock or bush often on a steep mountain slope, and generally well concealed. Eggs are laid at intervals of 48 hours. In one nest 21 eggs were found, probably the property of two hen birds!

Eggs measure as follows :—L., *46·3*×31·0. S., *37·9*×28·9. B., 44·4×*32·0*. N., 42·1×*28·0*. Average, 38 eggs, 42·1×30·7.

190. Alectoris græca pallescens. The Northern Chukor.

This chukor takes the place of the common chukor in the drier portions of Ladakh proper, and is found at elevations of from 9,000′ to 14,000′ more especially in the neighbourhood of cultivation. A pair of birds shot near Gya weighed respectively 18½ and 14 ounces, the male being the heavier bird.

A nest concealed at the base of a dwarf berberis bush near Khardong Pass at 13,000′ on the Shyok side of the Khardong Pass in Ladakh was discovered on July 22. It contained 12 nearly fresh eggs, indistinguishable from those of the common chukor.

They measure :—

L., *45·4*×31·4. S., *43·1*×30·9. B., 44·4×*31·6*. N., 43·4×*30·0*. Average of 12 eggs, 44·2 by 31·0.

191. Francolinus francolinus asiæ. The Northern Indian Black Partridge.

Not found in the Valley of Kashmir but occurs in the Jhelum Valley below Uri and on the outer lower slopes of the Pir Panjal Range.

192. Francolinus pondicerianus. The Grey Partridge.

Not found in the valley of Kashmir, occurs in the plains and foothills only.

193. Perdix hodgsoniæ hodgsoniæ. The Tibetan Partridge.

Found at high elevations, 14,000′ to 17,000′ in Ladakh, but is local and rare. It is not uncommon in Rupshu, especially from the Polokonka Pass down the Puga Valley, and also towards Hanle. It is found on rocky hillsides, especially in patches of caragana scrub.

194. Tetraogallus himalayenis himalayensis. The Himalayan Snow-Cock.

This large, handsome bird is found at high elevations throughout the mountains of Kashmir including the Pir Panjal Range. In Kashmir proper it is found from 12,000′ up to the snow line, and frequents open rocky or grassy slopes above the tree limit. It is also found in Ladakh especially Western Ladakh.

They are noisy and pugnacious birds in the spring. The call of the cock bird is of two kinds: (1) A clear whistle repeated 3 or 4 times at regular intervals of about a second, the notes rising in the scale so that the 4th or last note is an octave above the first. (2) A cry beginning with kuk, kuk, which is repeated about a dozen times, gradually quickening and also rising in the scale until the last high pitched notes follow each other so rapidly as to remind one of the acceleration of a ping-pong ball.

Two lots of eggs were brought to the writer from the hills above Leh at about 14,000′. They consisted of 7 slightly incubated eggs probably a full clutch, and two fresh eggs.

In the first lot the ground colour is cafe-au-lait, spotted and speckled all over with chocolate markings. In the second lot the ground colour is a dull pale green, and these are marked with pale pinkish brown.

The eggs vary in length from 71·0 to 62·5 and in breadth from 47·5 to 45·0, the average of one clutch being 70·7 by 47·2 and of the other 65·6 by 46·1.

195. Tetraogallus tibetanus tibetanus. The Ladakh Snow-Cock.

Occurs in Eastern and Southern Ladakh at even higher elevations than the last species, which it much resembles generally in its mode of life and habits.

196. Rallus aquaticus aquaticus. The Water Rail.

Common throughout the summer months and possibly resident in Kashmir. It is found throughout all the extensive jheels such as Hokar Sar, Anchar Lake, etc. They call chiefly in the early morning, a curious cry somewhat reminding one of the squeal of a small pig. They are extremely shy and wary keeping to long grass and reeds standing in shallow water.

They breed throughout June, July and August, 6 to 8 eggs being laid in a nest composed of reed-leaves on the ground in a swamp well concealed in standing grass and water plants.

The birds are difficult to flush and specimens are therefore difficult to obtain.

The eggs are pale cafe-au-lait rather sparingly spotted—chiefly at the broad end, with pinkish brown. They measure :—

L. ... *40·9* × 26·1 B. ... 36·6 × *27·1* } Average of 34 eggs, 36·3
S. ... *33·2* × 23·5 N. ... 33·2 × *23·5* } by 25·6.

197. Porzana pusilla pusilla. Eastern Baillon's Crake.

This is a common bird in the Valley of Kashmir, being found throughout the summer months in all the swamps, edges of lakes, etc. It is however much more frequently heard than seen, being a skulker in grass and swamp vegetation, and one that is flushed with difficulty. On one occasion, when searching for nests of this bird, one was seen running through the grass at the writer's feet and was mistaken for a rat. It was captured in the hand with some difficulty.

Nests are placed on the ground, in a swamp, well concealed in compara tively short grass and dwarf rushes, etc.

From five to eight eggs are usually laid from May to August which are dull greenish brown in ground, mottled with dusky brown on markings.

They measure :—

L. ... *30·3* × 21·0 B. ... 28·7 × *21·5* } Average of 82 eggs, 28·4
S. ... *26·6* × 20·3 N. ... 27·9 × *19·2* } by 20·6.

198. Amaurornis fuscus bakeri. The Northern Ruddy Crake.

This species is even commoner than the last being found in paddy fields as well as in swamps. In its skulking habit it resembles *Porzana*. Breeding commences in June, but July and August are the chief months.

Nests are composed of dry grass and the leaves of aquatic plants placed on the ground among grass, reeds or rice plants.

Six to 9 eggs are laid which are pale cafe-au-lait spotted all over chiefly at the broad end with pinkish-brown and pale purplish-grey markings.

Eggs measure :—

L. ... *35·4* × 24·0 B. ... 32·0 × *24·5* } Average (92 eggs), 32·6
S. ... *29·6* × 21·6 N. ... 29·6 × *21·6* } by 23·5.

199. Gallinula chloropus parvifrons. The Indian Moorhen.

Very common on all the lakes and larger jhils in the main valley, especially where beds of bulrushes abound, as in the Dal and Anchar Lakes.

In their habits they do not differ from the common moorhen of Europe.

Breeding commences in May and extends on into July. Eight or 9 eggs are commonly laid, but occasionally as many as 12. They resemble those of the Western Moorhen.

The nest is composed of a mass of bulrush leaves and is placed in dense patches of standing bulrushes, about a foot above the level of the water.

Egg measurements are as follows :—

L. ... *45·8* × 31·6 B. ... 44·8 × *32·9* } Average (71 eggs), 41·4
S. ... *38·3* × 28·0 N. ... 39·0 × *27·4* } by 29·6.

(A pigmy egg measures 22·5 × 18·5)

200. Fulica atra atra. The Common Coot.

Not uncommon on the lakes and jhils of the main valley, but not nearly so numerous as the Moorhen. A nest of the usual type was found in rushes on

the Anchar Lake on May 20. It contained 8 eggs which measure (average) 52·4 by 35·0.

201. Porphyrio poliocephalus poliocephalus. The Purple Coot.

A rare bird in Kashmir, but a few are usually to be found in the Anchar and doubtless other lakes in the valley. They undoubtedly breed in Kashmir but I have not seen a nest.

202. Megalornis nigricollis. The Black-necked Crane.

Occurs in Ladakh, in summer, at high elevations wherever the conditions are suitable. Three birds were seen early in June near the Tsokar Lake in Rupshu at 15,000′, and a pair near the Tsomoriri Lake at the same elevation in the third week of June. They did not appear to be breeding then. Later in the first week of July several pairs were seen in the swamps near Shushal at 14,000′ east of the Indus, but no nests were seen and no young birds. They undoubtedly breed in these swamps, but exactly when I was unable to ascertain.

The call of these birds is trumpet-like and resembles that of the Sarus Crane.

203. Hydrophasianus chirurgus. The Pheasant-tailed Jacana.

Fairly common throughout the summer months on the extensive jheels and weedy lakes in the main valley, especially in Hokar Sar and the Anchar Lake. The cry of the bird is loud and peculiar.

Breeding commences in May and continues until July, the eggs usually 4 in number but sometimes only 3, are peg-top shaped and of a dark olive-brown colour.

The nest is a slight accumulation of aquatic plant stems, placed in among floating plants, the eggs being only just above the water level.

Eggs measure :—

L. ... *38·7* × 28·1 B. ... 36·2 × *28·8* } Average (14 eggs), 37·2
S. ... *35·0* × 28·0 N. ... 36·6 × *26·4* } by 27·8.

204. Lobivanellus indicus indicus. The Red-wattled Lapwing.

The ' Did-he-do-it ' is not a common bird in Kashmir, but it is found occasionally in the main and larger side valleys up to about 6,000′.

A nest found near Shalabug in damp waste land contained four fresh eggs on May 25. The average measurement of these eggs is 42·9 by 31·1.

205. Vanellus vanellus. The Peewit.

A not every common winter visitor, found in the neighbourhood of wet ground in the main valley.

206. Charadrius mongolus atrifrons. The Central Asian Lesser Sand-Plover.

This pretty little plover is not uncommon in South and East Ladakh in summer between 13,000′ and 15,500′. They are found near lakes and streams as well as along the Indus River, and are very partial to stony or sandy plains provided water is not too far away.

The note of this bird is a peculiar one, a vibrating call, reminiscent of the note of the ice-bird (*Caprimulgus indicus*).

These birds were found breeding in Rupshu near the Tsokar and Tsomoriri Lakes (about 15,000′.) On the Indus at 13,000′ between the Indus and Shushat at 14,000′ to 14,500′ and along the Pangkong Lake at 14,000′. They were also found breeding in the upper portion of the Suru Valley at about 13,000′.

Egg laying commences about the middle of June and continues to the middle of July.

Three eggs only are laid in a slight depression scraped in the sand among stones or shringle.

The nest or rather nest cavity, for there is no nest, is very difficult to locate. The parent bird if disturbed by the approach of a man when incubating, gets up off the eggs very quietly and slinks away with lowered head after the manner of many other plovers. When returning toits eggs the approach is made very cautiously, and great care is necessary, even with the aid of a pair of field glasses, not to lose sight of the bird in the stretch of sand and stones among which it moves in a series of short runs.

The eggs are slightly pyriform and without gloss. The ground colour is café-au-lait, sometimes with a distinct warm tinge, speckled more or less all over with dark brown markings.

Eggs vary in length from 38·2 to 35·4 and in breadth from 27·2 to 25·6, the average of 12 eggs being 36·7 by 26·3.

207. Charadrius dubius jerdoni. Jerdon's Little Ringed Plover.

Not very common in Kashmir, but found by some of the larger streams where they enter the valley. A nest with four fresh eggs was found by the Sind River near Ganderbal (5,000′) on sandy, shringly ground on May 28. They also breed earlier than this, as on the same date a fully fledged young bird was observed.

The eggs are drab or pale khaki in ground finely speckled with very dark brown. They measure (average of 8 eggs), 28·9 × 21·5.

208. Himantopus himantopus himantopus. The Black-Winged Stilt.

This bird is not common in the Valley of Kashmir and its distribution is local. The only place where the writer met with this species was in swampy ground near the mouth of the Lidar River, but they undoubtedly occur in other parts of the valley.

They breed in the swamps in the valley.

209. Ibidorhynchus struthersi. The Ibis Bill.

This remarkable bird is not rare on some of the larger rivers of Kashmir and Western Ladakh. They frequent stony, sandy shores and especially islands. They emit when disturbed, a rather shrill mournful cry, something resembling that of the green shank.

They breed on stony, sandy islands often difficult of access in the summer, owing to the swollen condition of all streams from the melting snow. They were observed breeding on the Sind and Lidar Rivers at from 7,000′ to 8,000′ and again on the Ladakh side of the Himalayas in the Suru Valley from 9,000′ to nearly 12,000′.

Eggs, usually 4 in number, are laid in May and June on islands of sand, shingle and stones, with or without bushes of tamarisk, etc. The eggs are large for the bird, broad ovals, the ground colour being drab grey, and they are spotted and speckled, chiefly towards the broad end, with dark brown.

The eggs are laid in a slight depression in the sand, excavated by the parent bird, among stones or shingle. The nest cavity, in one instance, was found completely surrounded with hundreds of small stones, the size of a small split pea.

Two eggs found in the Lidar River (a full clutch) on June 14 (probably a second nest, the first having been destroyed by a flood) measure 49·8 × 38·6 and 52·0 × 38·9 respectively.

210. Tringa hypoleuca. The Common Sandpiper.

Common in Kashmir throughout the summer months breeding up all the chief streams and rivers, and especially in the Sind and Lidar, between 6,000′ and 9,000′. They also breed on the Ladakh side of the Himalayan Range in the Dras and Suru River beds from 9,000′ to 11,000′.

Eggs are laid during May and June chiefly on low islands in mid-stream, especially such as bear low shrubby vegetation of tamarisk, coarse grass, wild indigo, etc. Nests are composed of dry leaves and grass scraped together in a depression under the shelter of some small tamarisk or indigofera bush and are well concealed.

Eggs, 4 in number, are pyriform and slightly glossy, creamy white, spotted chiefly at the broad end with reddish-brown and sepia markings.

They measure :—L., *37·5* × 25·6. S., *32·5* × 25·2. B., 35·5 × *26·7*. N., 32·5 × *25·2*.

Average of 16 eggs, 35·5 × 26·0.

211. Tringa glareola. The Wood Sandpiper.

A fairly common winter visitor to the Valley of Kashmir.

212. Tringa ochropus.

Seen chiefly on the spring and autumn migration, both in Kashmir and Ladakh. They apparently return very early from their breeding haunts, birds having been noted in the Suru Valley at 12,000′ as early as July 18.

213. Tringa totanus eurhinus. The Eastern Redshank.

A not uncommon winter visitor in the Valley of Kashmir, breeding in Ladakh in swamps at from 13,000′ to 15,000′.

They are wild and wary birds and their nests which are generally placed in tussocks of grass in a swamp are difficult to locate.

They were found breeding by the Tsokar Lake and in the Puga Valley, at 15,000′ and 14,000′ respectively, in Rupshu. Also in the extensive swamps near Shushal, at 14,000′ and in the Rungdom swamps at 13,000′ in the Suru Valley.

Eggs both fresh and incubated, were taken in the first week of July near Shushal, and freshly hatched young in down were also seen. Eggs are elongated, pyriform and rather glossy, pale yellowish cafè-au-lait, marked with dark reddish-brown, chiefly at the broad end.

They vary in length from 48·9 to 43·9 and in breadth from 33·0 to 31·2, the average of 8 eggs being 46·1 by 31·8.

214. Tringa nebularia. The Greenshank.

A not uncommon winter visitor to the main valley.

215. Philomachus pugnax. The Ruff and Reeve.

A regular winter visitor but rather rare.

216. Erolia temminckii. Temminck's Stint.

A small party met with by the Indus River in Ladakh in May at 11,000′.

217. Erolia minuta. The Little Stint.

Occasionally seen in small parties on mud flats by the Jhelum River and Wular Lake in autumn and winter.

218. Scolopax rusticola rusticola. The Wood-Cock.

A resident in Kashmir but not so common as in Kulu and Garhwal.

In the summer they are found in fir and mixed forest, chiefly on northern aspects, both on the Pir Panjal and Himalayan Ranges, but especially the former and also in the Kishanganga Valley.

They breed in June and July at from 8,000′ to 10,000′. A nest near Gulmarg was in silver fir forest among dead leaves, etc., in the shelter of a skimmia bush. It contained 3 incubated eggs on July 20.

Eggs are dull whitish in ground marked with large pale reddish-brown and grey blotches.

The average of 5 eggs is 40·9×33·8.

219. Gallinago gallinago gallinago. The Fantail Snipe.

This is mainly a bird of passage, being found in fairly large, but varying, numbers, in the main valley in the early spring and late autumn, a certain number of birds remaining to breed. By April and early May birds may be seen 'drumming' over the marshes around the Hokra Jhil, which is carefully preserved.

Fresh eggs, four in number, may be found in these swamps from the middle of May. They are pale greenish-buff in ground, more or less richly marked with umber brown and grey spots and blotches. Eggs give the following measurements :—

L *39·0*×27·2. S., *35·7*×25·6. B., 36·5×*27·7*. N., 38·8×*25·9* (average, 29 eggs), 37·1×26·8.

220. Lymnocriptes minima. The Jack Snipe.

A fairly common winter visitor.

221. Rostratula benghalensis benghalensis. The Painted Snipe.

This species is common and resident in the swamps of the main valley. They are found breeding in the Hokra Jhil along with the common snipe.

They chiefly breed in May, the nest being placed in similar situations to that of the common snipe. Although the bird is larger than the common snipe its eggs are decidedly smaller. They are yellowish in ground boldly and heavily marked with dark brown almost black blotches, and are glossy.

They measure :—
L., *37·0*×25·2. S., *32·8*×24·8. B., 35·8×*27·2*. N., 33·4×*23·6*. Average, 43 eggs, 35·4×25·3.

222. Larus ridibundus ridibundus. The Black-headed Gull.

A common winter visitor in the valley, especially in the vicinity of the Wular Lake.

223. Larus brunnicephalus. The Brown-headed Gull.

This gull is occasionally seen in the Valley of Kashmir as a cold weather visitor. In the spring they leave for higher altitudes and in summer they are found breeding in coloniesin Ladakh by the salt lakes. In Rupshul, by the Tsokar and Tsomoriri Lakes they are fairly numerous, but no eggs had been laid up to June 21st, but judging from the behaviour of the birds, they were then about to commence breeding. The cry of these birds on their breeding grounds is very like that of the jungle crow.

A few birds were seen near the Pangong Lake in July but no breeding colony was met with.

224. Chlidonias leucopareia indica. The Indian Whiskered Tern.

Exceedingly common throughout the summer on all the lakes and larger jhils in the Valley of Kashmir. Most of the birds arrive in April and breeding commences towards the end of May.

Two or three eggs are laid on an apology for a nest consisting of a collection of the stems of water plants among floating water lilies, lotus and other aquatic plants. The nests rise and fall with the water, upon which they float, and the eggs are usually only a fraction of an inch above the water level.

Two or three eggs constitute a full clutch, but four or five have more than once been found in one nest, but in such cases the eggs were evidently the joint property of two hen birds. The eggs vary in size and colour to a great extent. They are, in ground, usually some shade of yellowish-brown or pale green, marked chiefly in a zone at the large end with deep brown chocolate brown or purplish sepia spots. The eggs are collected in large numbers by the villagers and sold to the European visitors in Srinagar as ' Plovers ' eggs !

Eggs measure as follows :—
L., *41·8*×27·0. S., *32·8*×26·7. B., 38·2×*29·5*. N., 33·8×*25·6*. Average (72 eggs), 37·0×27·4.

225. Sterna hirundo.

A tern which is either *S. h. hirundo* or *S. h. tibetana* was seen fairly frequently by the Tsomoriri Lake in Rupshu, at Puga, on the Indus and along the Pangong Lake between 13,000′ and 15,000′. This was in June and July. They were also seen in July on the upper reaches of the Suru river at about 13,000′. They evidently breed in all these localities, but no nests were seen.

226. Phalacrocorax carbo sinensis. The Indian Large Cormorant.

Common in the lakes and larger jhils in the Valley of Kashmir. Probably resident.

227. Plegadis falcinellus falcinellus. The Glossy Ibis.

A solitary bird was seen feeding by the Dras River, near Dras, at 10,000′ on May 3. It was evidently a straggler.

228. Ardea cinerea cinerea. The Common Grey Heron.

Very common and resident in the Valley of Kashmir, being found near all the lakes and larger jhils, and penetrating up the larger side valleys, e.g. the Lidar up to about 7,000′.

They breed in colonies in the largest and most inaccessible chenar trees. Breeding commences in March, at which time many fresh eggs may be found lying broken below the trees in which they are nesting. Possibly these eggs are ejected in the struggle for nesting sites.

229. Ardeola grayi. The Indian Pond Heron.

This bird is locally common, e.g. on the Anchar Lake where they are resident.

They breed in May in the willows around the edges of the lake, usually in small colonies.

Four or five eggs are laid, which are blue and glossless.

Eggs measure :—

L. ... *41·0* × 29·6 B. ... 36·1 × *30·1* } Average (27 eggs), 38·0 by
S. ... *35·6* × 29·21 N. ... 35·0 × *27·0* } 27·9.

230. Nycticorax nycticorax nycticorax The Night Heron.

Very common in the lakes and larger jhils in Kashmir.

They breed in large colonies, either alone or in company with the grey Heron, in May, laying 4 eggs similar in colour to those of the pond heron.

They measure :—

L. ... *52·7* × 35·9. B. ... 52·3 × *36·2* } Average (18 eggs), 49·5 by
S. ... *46·7* × 33·3. N. ... 49·4 × *32·8* } 34·8.

231. Ixobrychus minutus minutus. The Little Bittern.

Extremely common in the beds of bulrushes in the Dal and other lakes and jhils in the valley.

They breed throughout May and June in the bulrush beds, which stand in water about 2 feet deep. The nests are composed of the leaves of the rush and are attached to the rushes about a foot above the water level. From 5 to 7 eggs are laid which are rather elliptical in shape, pure white and glossless.

They measure :—

L. ... *37·4* × 24·7 B. ... 35·8 × *27·2* } Average (78 eggs), 34·5 by
S. ... *32·1* × 25·7 N. ... 35·3 × *23·7* } 25·5.

232. Botaurus stellaris stellaris. The Bittern.

This is not a common bird in Kashmir but it occurs in some of the denser, more extensive reed beds e.g. near Shalabug. The natives assured me that they had found the nest and eggs on several occasions and it is probable that the bird does breed in the valley though I failed to find a nest.

233. Anser anser. The Grey Lag Goose.

Visits the Kashmir Valley in winter in huge flocks.

234. Anser albifrons albifrons. The White-fronted Goose.

Also a winter visitor to Kashmir, but not usually common.

235. Anser indicus. The Bar-headed Goose.

This small goose is found in fairly large numbers in Ladakh in summer where they breed between 12,000′ and 15,000′. Eggs are laid from the last week in May to the first week in June. They were found breeding near the Tsokar and Tsomoriri Lakes in Rupshu at 15,000′ elevation between the June 8 and 21. A colony of 15 pairs had nests on a silt island in the Tsomoriri lake. The nests were in slight depressions scraped in the silt or 3″ or 4′ above the water level and were not concealed, the island being absolutely devoid of vegetation.

Six appears to be the maximum full clutch. The eggs are large for the size of the bird ; a goose shot from the nest weighing 4½ lbs. and her 6 eggs, 29 ounces !

They are rather elongated ovals, pale creamy white where fresh, but becoming much discoloured as incubation proceeds. When islands are not available as nesting sites, these birds will lay on rocky cliffs. One such nest was found in a deserted raven's nest on a vertical cliff near the Tsokar Lake. In every case the eggs are surrounded or covered with down.

Other breeding localities noticed were the Indus River near Nimu Mut (13,500′) and a small swampy lake near Shushal at 14,200′.

Egg measurements give the following figures :—

In length, from 87·2 to 72·3. In breadth from 58·5 to 51·2.

Average 47 eggs, 82·6 by 55·3.

236. Casarca ferruginea. The Brahminy Duck.

A not very common winter visitor to Kashmir, retiring to Southern and Eastern Ladakh in summer to breed. Fairly large numbers were found

breeding in the hills in Rupshu around the Tsokar and Tsomoriri Lakes, as well as at Puga.

Breeding commences early in May, ducklings being first observed on the water on June 12.

Nests are usually at a considerable distance from the water, in holes in the rocky hillside or among boulders, on rocky cliffs. The young ducklings are brought down to the water by their parents as soon as they are hatched. They appear to bring them down two at a time, for on one occasion I saw a pair fly down from the hills and alight on the water and then noticed they had 2 ducklings with them. I did not unfortunately see how the transportation was effected.

When at Puga, in Rupshu, where there are hot springs and sulphur and borax deposits, I saw many families of these ducklings running about among the swamps. They were of various ages—some very young, others fully 2 or 3 weeks old, but none could fly. This was on June 26. The maximum number of ducklings in one family was 8. No eggs were found.

237. Anas platyrhyncha platyrhyncha. The Mallard.

One of the commoner ducks which visit Kashmir in the winter. A fair number of birds remain in Kashmir to breed.

Breeding commences about the middle of April and fresh eggs may be found throughout April and May.

The nest is usually well concealed in reeds or rushes—as many as 12 eggs are laid which are very pale greenish ' khaki ' in colour.

They measure :—

L., *59·4* × 42·2. S., *53·2* × 41·2. B., 58·3 × *42·4*. N., 55·2 × *39·2*. Average (11 eggs) 56·3 by 41·3.

238. Chaulelasmus streperus. The Gadwall.

A fairly common winter visitor.

239. Mareca penelope. The Wigeon.

Also fairly common in winter.

240. Querquedula querquedula. The Garganey.

Common on the spring and autumn migrations.

241. Nettion crecca crecca. The Common Teal.

Very numerous throughout the winter months. A few are occasionally seen also in summer and possibly they may rarely breed in the valley. These are probably ' pricked ' birds.

242. Dafila acuta. The Pintail.

Common on the spring and autumn migrations. A few birds remain throughout the winter.

243. Spatula clypeata. The Shoveller.

Fairly common in the winter.

244. Marmaronetta angustirostris. The Marbled Duck.

Rather a rare winter visitor. I have only seen two birds shot in three years.

245. Netta rufina. The Red-crested Pochard.

Common in winter.

246. Nyroca ferina ferina. The Dunbird.

Fairly common in winter.

247. Nyroca marila marila. The Scaup.

A rare winter visitor.

248. Nyroca rufa rufa. The White-eyed Pochard.

Common and resident. Breeding commences in May, and fresh eggs may be found throughout May and June. The nest is placed on or near the ground

in dense reeds, grass or bulrushes and is well concealed. About 11 eggs is the full clutch. They are coloured a rather warm cafè-au-lait.

Egg measurements are as follows :—

L., *53·2* × 37·6. S., *48·3* × 36·3. B., 52·7 × *37·9*. N., 49·1 × *35·3*. Average (27 eggs), 50·5 by 36·9.

249. Nyroca fuligula. The Tufted Pochard.

Not uncommon on the spring migration.

250. Glaucionetta clangula clangula. The Golden-eye.

A rare winter visitor.

251. Erismatura leucocephala. The Stiff-tailed Duck.

Not common but a regular winter visitor.

252. Mergus albellus. The Smew.

Not common, but occasionally seen in the winter months on the Wular Lake. Colonel Ward found them breeding on the Shyok river in Ladakh.

253. Merganser merganser orientalis. The Eastern Goosander.

Occasionally seen in Kashmir, it is a regular summer visitor to Ladakh where it breeds on the Indus river and near the lakes in Rupshu, as well as near the Pangong lake in June.

254. Podiceps cristatus cristatus. The Great Crested Grebe.

Rare in Kashmir (I have seen one bird shot). They were found breeding in a colony by Col. Meinertzhagen by the Tsokar Lake at 15,000′ in Rupshu (Ladakh).

255. Podiceps ruficollis albipennis. The Indian Little Grebe.

Very common throughout the Kashmir Valley in jhils and reedy lakes in summer. Not nearly so numerous in winter.

Breeding commences from early May and continues till July. From 4 to 6 eggs are laid which are pure white the day they are laid, but they very rapidly become stained, but not uniformly a dirty brown, occasionally they may even become a deep chocolate.

The eggs are laid on a floating mass of decaying vegetable matter collected by the birds, and the eggs are only raised an inch or so above the water. When the parent bird leaves the nest she covers the eggs with a portion of the nest material.

Eggs give the following measurements :—

L., *38·8* × 26·0. S., *34·3* × 25·1. B., 36·3 × *26·3*. N., 38·8 × *23·2*. Average (32 eggs), 36·6 by 25·1.

ON THE BREEDING HABITS AND FECUNDITY OF THE SNAIL *LIMNÆA LUTEOLA*.[1] LAMARCK (FORMA-TYPICA)

BY

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(*With two plates and two graphs*)

The breeding habits and fecundity of *Limnæa luteola* Lamarck forma typica [2] were the subject of my observations during the past three years. The observations were made on (1) individuals reared in the aquaria in the laboratoy, (2) individuals kept isolated in the laboratory, (3) individuals kept in big troughs of water in the open air (in a garden), and (4) individuals in their natural haunts.

The species in question is the only species available in Tirupati and my observations are practically confined to it. But I had an occasion once to get live specimens of *Limnæa acuminata* from elsewhere and they also were under observation for some time. So far as fecundity is concerned *Limnæa acuminata* also presents the same features as *Limnæa luteola*.

Limnæa luteola seems to attain sexual maturity in about ten months. It is not definitely known how many times an individual breeds during its lifetime. In attempting to find out this, two difficulties were experienced. One was that the exact duration of life of individuals could not be definitely ascertained, for the adult individuals could not be kept alive in the aquaria for over five or six months in spite of all possible care bestowed on them. Young individuals hatched from the eggs could however be kept alive much longer. But from observations made on the rate of growth of the individuals, on the size attained in a year by individuals kept under natural conditions in open surroundings, and judging from the maximum size attained by individuals we may assign to this species of *Limnæa* three years as the duration of life. On the strength of my observations, I can confidently assert that it is more than two years.

The other difficulty was that of ascertaining the exact breeding season. I could collect eggs at all times of the year. At first it seemed as though the species was breeding right through. But I kept the individuals isolated in the laboratory and observed that they breed for about four to five months. Individuals lay eggs in abundance for a time and then gradually cease their breeding. That eggs are found in abundance at all times of the year is to be explained as due to different sets of individuals reaching sexual maturity at different periods of the year, and thus some individuals or other in a tank are found breeding right through. We cannot therefore speak of any definite breeding season for this species of *Limnæa*. The individuals of the species have each their own breeding period of life, but there seems to be no breeding season for the species as a whole.

Limnæa is of course oviparous like the majority of *Mollusca*. An individual about to lay eggs attaches itself by its foot to a leaf, or in the aquarium, to the wall of the aquarium. It remains steady for a short while and as the mass of eggs embedded in the jelly-like substance issues out, the animal recedes very slowly. It takes about twenty to twenty-five minutes for an animal to lay a batch of about 120 eggs.

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[1] From a paper read before the Indian Science Congress (1927) held at Lahore.

[2] My thanks are due to Major Seymour Sewell and Dr. H. S. Rao for the identification of species.

The eggs are laid as indicated above in capsules embedded in a jelly-like gelatinous substance. This jelly is more abundant than in the case of egg masses of *Indoplanorbis exustus* and the egg capsules are unlike those of *Indoplanorbis exustus* in not being tough. Each batch of eggs contains usually three or four rows of oval eggs capsules. The egg masses are laid on some substratum like leaves, stones, shells of other *Mollusca* like *Vivipara*, *Pila globosa*, etc. The length of the batch varies according to the number of eggs. I have often come across batches nearly 2″ long. The average number of eggs in a batch is about thirty-two.

For observations on their fecundity, I kept a number of individuals isolated. The statistics for the frequency of laying eggs and for the variation in the number comprising a batch are given in the end. It will be sufficient here to refer simply to the general feature of the fecundity of *Limnæa luteola*.

(1) Average frequency of laying eggs per individual :—Once in two days.

(2) Average number of eggs individuals per batch :—Thirty-two.

Generally speaking an individual under normal conditions lays eggs once in about two to three days, sometimes more frequently, sometimes with regularity. In the course of about three months an individual could lay as many as forty-seven batches. The average number of eggs per batch for this individual was thirty-four.

Mr. Ramanan [1] speaking of the Madras specimens, says that the spawn was laid once in a fortnight. Professor J. A. Thomson[2] speaking of *Limnæa stagnallis* says, ' the eggs are laid through the summer and attached in clumps of about thirty to water weed, each clump being surrounded by a curved mass of jelly about an inch long. . . . They hatch out in a month.' It is evident that *Limnæa luteola* of Tirupati differs in these respects not only from its British cousin but also from the Madras one, for in the species under consideration, eggs hatch out in about ten days and the eggs are laid throughout the year.

The number of eggs in the successive batches laid by an individual alternately rises and falls—(*vide* statement and the graph, page 160). If, for example a large number of eggs, say fifty in number, are laid in a batch, the number in the next batch will be something less; and after one to three batches it usually goes up again, only to fall again. Below are noted the number of the eggs in the successive batches laid by an individual. More or less the same phenomenon has been noted in a large number of individuals.

Batch No.	No. of eggs	Batch No.	No. of eggs
1	39	14	28
2	54	15	6
3	39	16	21
4	20	17	30
5	60	18	30
6	39	19	42
7	45	20	25
8	29	21	30
9	51	22	16
10	33	23	23
11	21	24	29
12	35	25	19
13	52		

Another feature worth noting and which has been observed in some of the individuals examined, is that with the increase in the number of batches laid

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[1] *Non-marine Mollusca of Madras and Its Vicinity* by V. V. Ramanan (1900), Premier Press, Madras.

[2] *The New Natural History*, by J. A. Thompson, page 906 (1926). George Newnes, Ltd., London.

by the individual, the number of eggs in the batch generally tends to decrease. The following figures show the average for every successive batches of eggs laid by an individual.

1st five batches	...	...	...	...	42
2nd ,, ,,	...	...	...	. .	38
3rd ,, ,,	...	...	...	...	33
4th ,, ,,	...	...	...	...	25
5th ,, ,,	...	...	...	...	25

It is clear that the average tends to fall with the rise in the number of batches laid by the individual.

Taking three years as the minimum duration of life of *Limnæa* it is possible to estimate the number of eggs laid by a single individual. An individual seems to breed for about four months in the year, though all the individuals in a tank do not breed at the same time of the year. During these four months about forty to fifty batches of eggs are laid, with about thirty-two eggs in each batch on the average. Thus in three years a single individual might lay about five thousand eggs. This is quite a prolific breeding. In their natural environment the breeding appears to be more prolific, for, I come across egg masses which are often much longer than those laid in captivity. Ordinarily one embryo is contained in an egg, but rarely two, three, seven or even nine embryos are found. The young ones hatch in about ten to eleven days in the cold season and in about nine to ten days in the summer season.

Limnæa are hermaphrodite. Annandale and Prashad [1] state that certain species are functionally protandrous and pair when the male organs are ripe. Annandale and H. S. Rao [2] state that they have much indirect evidence to show that this condition prevails in most species. They also state that prostrate and spermatheca are fully developed in the same individual only rarely and that egg masses are rare in tanks in which the snails are mating and conversely, when individuals are mating, egg masses are not common. I cannot speak the same of the species in Tirupati. I find the egg masses are common right through the year but the mating of the individuals takes place only from March to August. That is, even when the individuals are mating, the egg masses are quite plenty. I have closely watched the mating individuals and after separating them immediately after mating, kept a record of their subsequent behaviour.

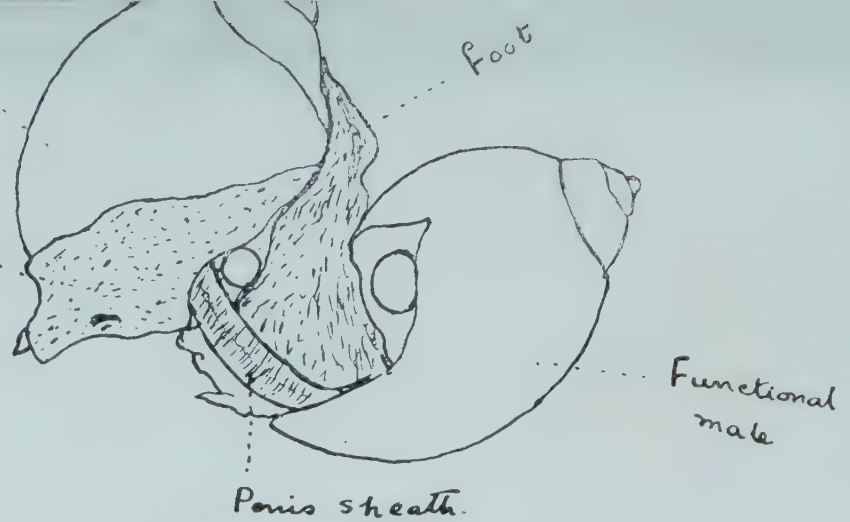
First as to mating :—Of the two individuals that pair one is frequently slightly bigger and this is usually the functional male. The other is a little bit smaller and is the functional female. The copulation between the individuals lasts for about forty minutes and is not reciprocal. The individuals that are to mate come to the surface of the water. The functional female attaches itself by means of its foot to some foreign object, the side of the jar in my aquarium, and remains steady. The other individual attaches itself to the shell of the former and protrudes the whitish penis sheath and introduces it into the other animal. The movements of the penis as the sperm passes along are clearly visible through the translucent penis sheath. The mantle opening which can be seen by the side of the penis sheath is opened about every three minutes to renew the air in the mantle cavity. Sometimes the air is renewed at much longer intervals. On one occasion three individuals were found copulating together. Sometimes both float to the surface.

After mating both the individuals sometimes lay eggs that very day : sometimes one day or two later but never much later. So we cannot always conceive of the sperms being stored up for any length of time before the ova are fertilized.

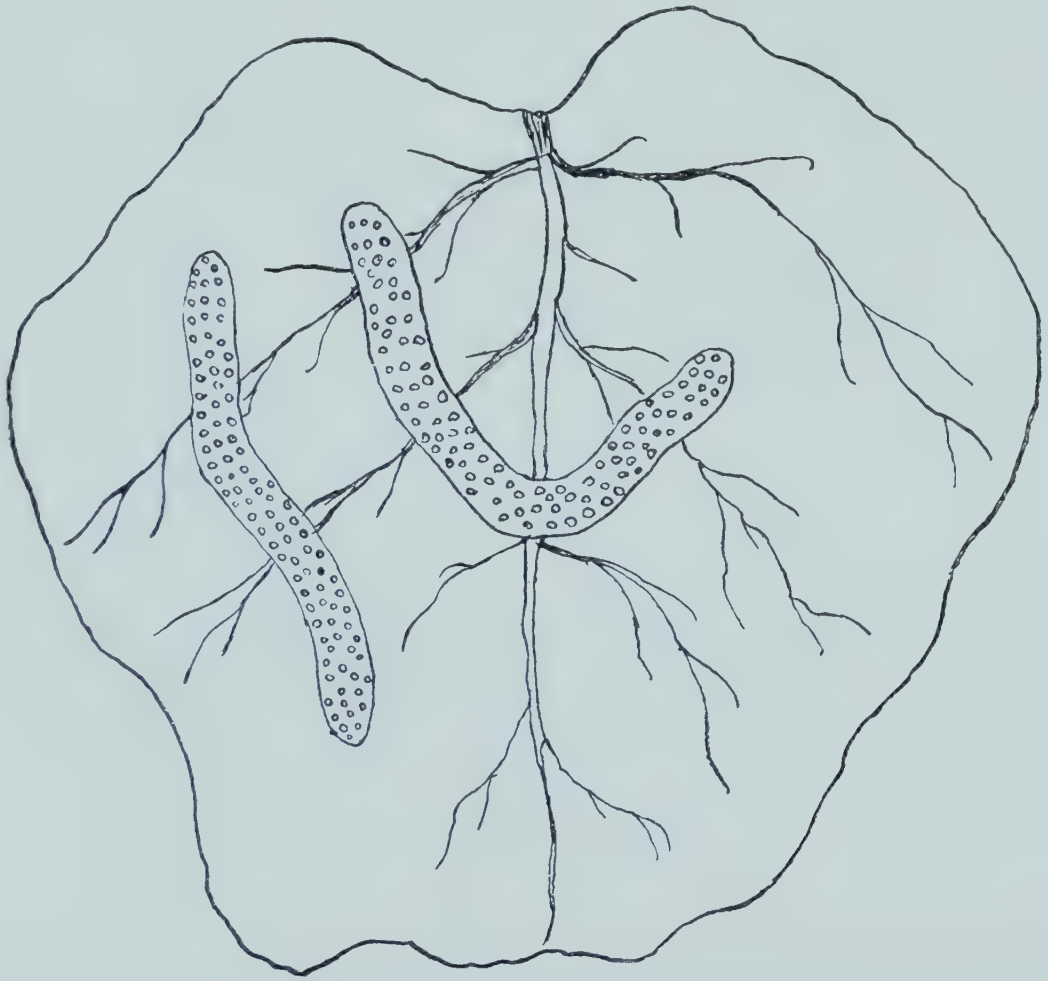
[1] *Records of the Indian Museum*, vol. xxvii, p. 138 (1925).
[2] *Ibid.*



1. *Limnæa* LAYING EGGS ON THE SIDE OF A GLASS JAR.

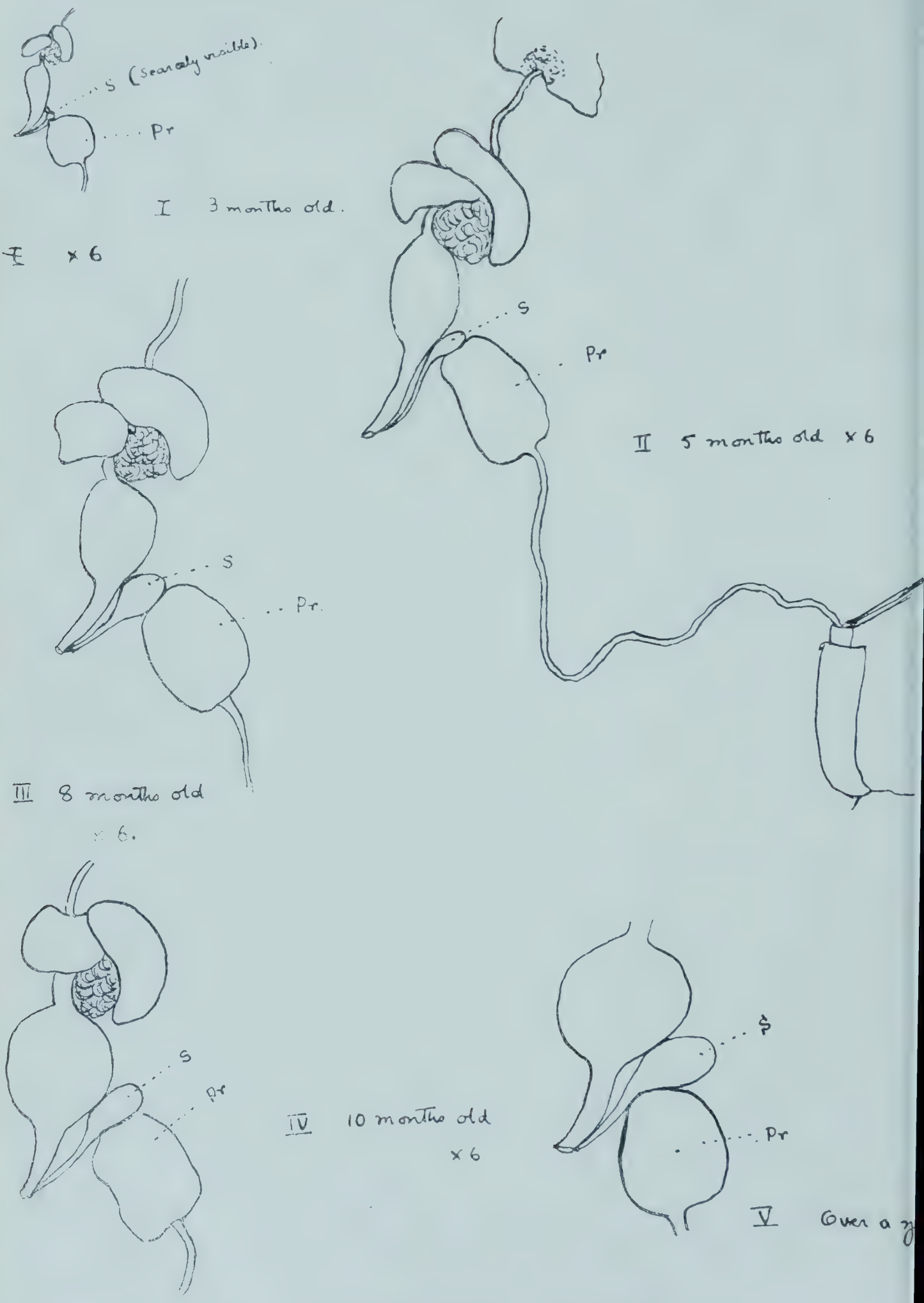


3. MATING IN *Limnæa luteola*.





4. EGG WITH NINE EMBRYOS.



Pr. = Prostrate Gland ; S. = Spermatheca.

SKETCHES SHOWING RELATIVE DEVELOPMENT OF MALE AND FEMALE GENITALIA AT DIFFEREN PERIODS OF LIFE.

Below is the record of two individuals that mated on the 23rd August, 1925.

COPULATING INDIVIDUALS

Date	Functional female No. of eggs	Functional male No. of eggs
23rd August, 1925	23	27
24th ,, ,, ...	...	...
25th ,, ,, ...	...	...
26th ,, ,, ...	...	49
27th ,, ,, ...	20	...
29th ,, ,, ...	17	24
31st ,, ,, ...	17	13
2nd September, and so on ...	16	19
	25	21
	29	16
	16	15
	11	15
	12	18
	7	13
	9	12
	6	16
	died	13
		12
		3
		5
		9
		3
		4

Then again the reproductive organs of two mating individuals were examined. In the functional female the prostrate and the spermatheca were both well developed. The spermatheca and its duct contained sperms. The hermaphrodite gland showed sperms and ova well developed.

In the functional male also both the spermatheca and prostrate were well developed but in the spermatheca there were no sperms as in the functional female.

This would show that in both the mating individuals both sperms and ova are ripe and the male and female genitalia are equally ripe. And we have already seen that both the mating individuals begin to lay eggs soon after mating.

A few individuals that had been laying eggs for a long time were examined. They showed both sperms and ova well developed in the hermaphrodite gland. The spermatheca also contained sperms.

Young individuals of about four months or a little younger were examined. The spermatheca was minute and the uterus was small. In the hermaphrodite gland, sperms were developing but no ova. Again individuals of about 7 or 8 months were examined. The spermatheca was not yet of its maximum size but the prostrate was well formed. The hermaphrodite gland showed sperms but ova were not quite ripe.

Individuals are certainly protandrous in the first year of their life, but considerable time does not lapse between the development of the two sets of genitalia. In older individuals both ova and sperms are ripe and both the genitalia are ripe at the same time. This suggests the possibility of self-fertilization, for I note that isolated individuals can breed for a long period of four months and of the mating individuals, the functional male also lays eggs soon after mating, though it does not show signs of having received sperms from another individual prior to laying eggs. This problem needs a thorough investigation probably from a cytological standpoint.

The fact that isolated individuals can lay considerable number of eggs for a long period would show that the ova get fertilised batch after batch. And as the stock of germ cells gets exhausted there is a decline in the number of eggs laid. But the significance of the interesting features shown elsewhere about

the fecundity is not known. Sometimes I find that the number of eggs laid by an individual having come very low, suddenly rises up.

Sedgwick mentions of cases of *Limnæa* that have been kept isolated for life and that have laid eggs. These, he says, might be cases of parthenogenesis. But there is no parthenogenesis in the species I have been observing.

Another interesting feature of breeding of *Limnæa* has been noticed. The fecundity seems to be susceptible to environmental influences. Though I am not in a position to give detailed statistics at present to show the relation between fecundity and environment, yet sufficient evidence is available for me to state that environmental variations do affect the breeding of *Limnæa luteola*.

For a month a number of individuals were kept isolated in separate jars. The water was not changed and the food which consisted of leaves of *Vallisneria* was not renewed. Many of these individuals had been laying eggs regularly but under the changed conditions the breeding ceased abruptly. Again a number of individuals were kept crowded for about a week without food. The number of eggs laid was very low. But the same individuals after being placed in fresh water with a fresh supply of leaves, began laying eggs regularly. This was observed on many occasions. It is worth finding out what exactly is the connection between fecundity and nutrition here.

In fine the breeding habits of *Limnæa luteola* present many problems of interest which need elucidation. The regular rise and fall of the number of eggs laid, the capacity of isolated individuals to breed for a prolonged period, the phenomenon of both the mating individuals laying eggs soon after mating, though mating is not reciprocal, the influence of environmental changes on breeding,—these are some of the problems that require explanation. It is also necessary to find out where in the genitalia, and how, when, and how often, the fertilization of ova takes place.

NOTE ON THE STATEMENTS AND GRAPHS APPENDED TO THIS ARTICLE.

Statement A, Page 160

This statement shows the variation in the number of eggs in the successive batches laid by an individual.

Statement B, Page 162

This shows the total number of eggs in the batches recorded and the average per individual per batch.

Statement C, Page 162(A)

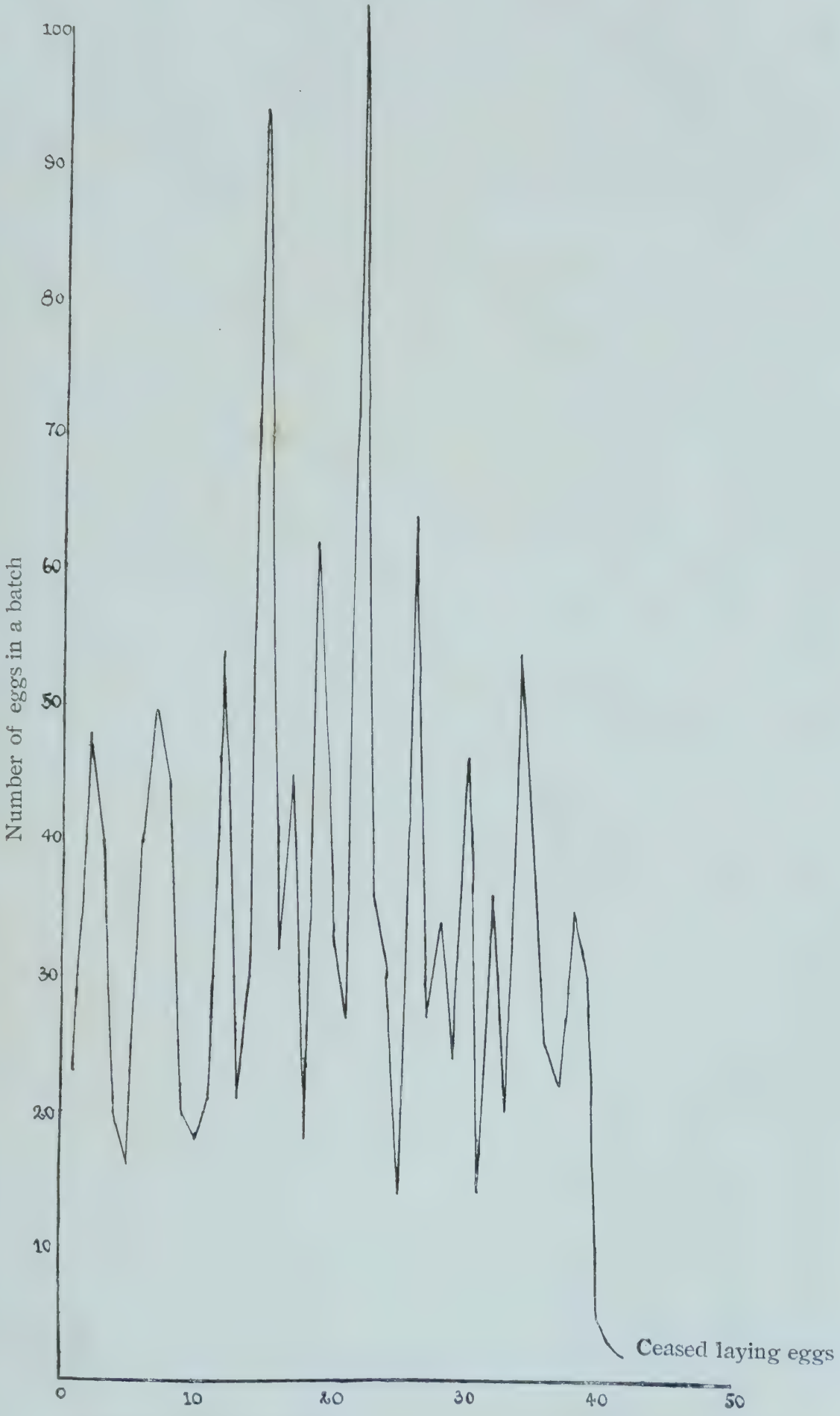
This shows the frequency with which eggs are laid.

Graph I

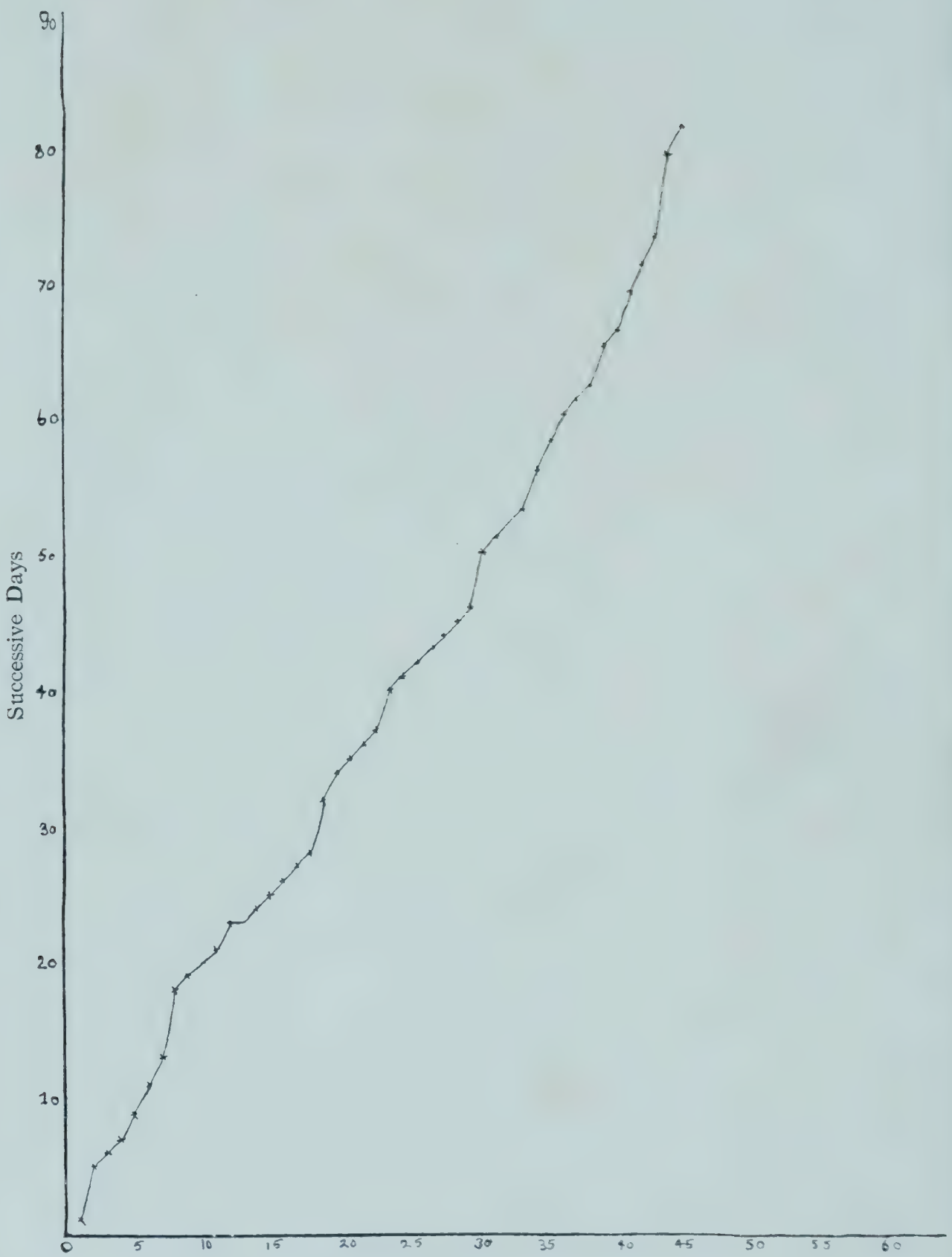
This graph shows the variation in the number of eggs in successive batches laid by an individual. It will be seen that after rising high the number of eggs per batch comes low and after one to three batches rises again. Then it comes low and so on.

Graph II

This graph will give an idea of the frequency with which the eggs are laid. It will be seen that eggs are laid successively for two to four days and then there is a break after which eggs are again laid regularly.



GRAPH SHOWING THE NUMBER OF EGGS IN SUCCESSIVE BATCHES LAID BY INDIVIDUAL C.



GRAPH SHOWING THE FREQUENCY OF EGG LAYING BY INDIVIDUAL C.

A. STATEMENT SHOWING THE NUMBER OF EGGS IN SUCCESSIVE BATCHES LAID BY A NUMBER OF INDIVIDUALS

Number of Batch	Name of Individual																		Remarks
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	36	39	23	43	54	40	33	25	45	24	39	29	54	63	35	35	54	55	44	
2	60	54	48	40	84	72	10	7	40	35	69	64	34	39	81	105	55	60	16	
3	35	39	40	39	12	9	13	16	18	11	60	51	20	97	27	60	40	28	8	
4	31	20	20	39	31	34	34	57	32	24	54	72	42	26	9	48	54	78	10	
5	24	60	16	54	39	38	20	5	7	4	60	36	32	80	8	36	39	85	34	
6	16	39	40	29	29	20	66	44	35	25	27	25	30	40	7	24	9	72	34	
7	52	40	50	39	63	11	19	12	28	15	63	27	30	20	14	13	11	20	16	
8	21	29	44	39	51	26	18	27	18	12	36	18	19	59	26	64	22	34	15	
9	14	51	20	33	32	18	20	18	15	22	36	42	12	39	18	39	9	29	24	
10	63	33	18	34	29	4	19	15	10	18	99	40	27	16	32	39	24	42	32	
11	45	21	21	28	98	16	16	20	58	9	24	19	14	29	27	36	9	72	99	
12	34	35	54	34	53	14	13	9	27	7	94	39	24	59	18	32	8	44	60	
13	48	52	21	...	28	...	4	6	26	6	128	19	33	60	5	45	12	42	45	
14	20	28	31	...	74	...	4	8	8	16	102	24	11	33	4	19	24	64	30	
15	54	29	94	...	14	...	...	18	18	11	140	63	42	30	34	24	14	12	49	
16	22	6	32	...	24	...	...	34	11	20	94	27	32	20	34	64	12	18	27	
17	16	21	45	...	14	...	...	12	9	...	34	14	19	18	...	30	34	...	45	
18	35	30	18	...	34	...	...	37	28	...	24	54	10	29	...	36	10	...	69	
19	15	42	62	...	...	...	...	8	12	...	21	59	18	37	...	30	...	...	48	
20	65	25	35	...	...	...	...	22	10	..	29	14	6	25	...	11	...	...	56	
21	7	39	27	...	...	...	...	15	14	...	14	34	24	9	...	32	...	...	24	
22	19	16	102	...	...	...	...	9	17	...	13	45	32	60	...	14	...	...	39	
23	34	23	36	..	...	...	.	2	...	...	25	34	26	34	...	...	...	...	28	
24	19	29	30	...	...	..	...	..	...	...	7	28	25	102	...	...	...	...	43	
25	34	19	14	..	...	...	...	...	...	...	24	6	34	54	...	...	...	...	34	
26	4	34	64	...	...	...	...	...	...	...	30	...	...	14	...	...	...	...	26	
27	36	...	27	...	...	...	...	...	...	...	20	...	...	26	...	...	...	...	...	
28	13	...	34	...	...	...	...	...	...	...	95	...	...	56	...	...	...	...	...	
29	...	...	24	...	...	...		...	...	...	15	...	...	8	.	...	...	...	...	

batches of eggs, but only those whose record of eggs was for the individual per year which is likely to be greater.

Total.	A 872	B 853	C 1,420	D 451	E 763	F 302	G 229	H 426	I 486	J 50	K 1,576	L 887	M 680	N 1,182	O 879	P 836	Q 470	R 755	S 855

As will be noted from Statement (C), these individuals have laid more maintained are noted here.
The number of batches or of eggs recorded does not represent the maximum

B. STATEMENT SHOWING THE TOTAL NUMBER OF EGGS AND BATCHES RECORDED AND THE AVERAGE PER INDIVIDUAL PER BATCH

Name of Individual	Number of batches recorded	Total number of eggs	Number of eggs per batch
A	28	872	31
B	26	853	33
C	42	1,420	34
D	12	451	38
E	18	763	42
F	12	302	25
G	14	229	16
H	23	426	19
I	22	486	22
J	16	259	16
K	34	1,576	46
L	25	887	35
M	25	680	27
N	28	1,182	42
O	16	379	25
P	22	836	38
Q	18	470	26
R	16	755	47
S	26	955	37

Average per Individual per batch = 32.

A JOURNEY ACROSS THE HIMALAYAS

BY

J. W. BORRADAILE

(With four plates)

Looking northwards from Simla, the great Himalayan chain appears to form an unbroken barrier, yet at this point it is crossed by one of its oldest caravan routes, one branch of which goes to Tibet; the other passes through Kulu, Lahoul and Ladak. In order to save time on my journey to Lahoul, I did not take the road from Simla, but motored from Pathankot through the beautiful Kangra Valley, and after crossing the Bubbu Pass over the outer Himalayas, I descended through a forest of huge pines and joined the road in the valley of Kulu.

Kulu is the basin of the River Beas. It has a wide cultivated area overhung by giant forests, above which in a complete ring can be seen the snows of the Central Himalayas. It can be reached at any time of the year and it is famous for its orchards. Kulu Valley is soon to be opened up by a first class road and then the difficulties of reaching it during the winter will be at an end.

There are always traders' camps on the banks of the Beas and an inspection of their wares is interesting. Travelling in the valley is very comfortable as the road is good and there are dâk bungalows at each stage.

Kulu can be reached in six days from Pathankot by ordinary stages. Cost of motor is Rs. 20 per seat; mules Rs. 1-4-0 per stage; coolies have tehsil rates according to the length of the march, approximating at 8 as. with a bonus for the high passes. Eggs and chickens are large and cheap. The trout fishing is excellent though, early in the year, it is spoilt by the snow water. In addition there is pheasant and woodcock shooting during the winter, also red and black bear. Unfortunately the number of licences issued each year is very limited, so the Forest Officer should be applied to early.

After four days I reached the foot of the Rohtung Pass, and although I had intended to camp some way up, I was compelled to spend the night at Rahla rest house, on account of the heavy rain, and this caused me many difficulties on the following day.

The Rohtung Pass is only 13,500 feet above sea level, but it is famous for its daily hurricane, which starts at nine every morning. I had engaged two mules at the start of my journey and had since got a third with which to cross the pass. Owing to a late fall of snow, the pass, though easy for foot traffic, was very difficult for mules, which do not take to the snow nearly so well as the little Yarkhandi and Spiti ponies.

In spite of repeated warnings that I should be over the pass before sunrise, a start was not made until 4 a.m. The summit was gained without any difficulty about an hour after dawn, and it seemed as if the passage would be a very easy one.

Looking over into Lahoul from the Rohtung Pass is like entering a new world. Gone are the forests and cultivation, and in their place, as far as the eye can see in every direction are peaks and glaciers without so much as a blade of grass.

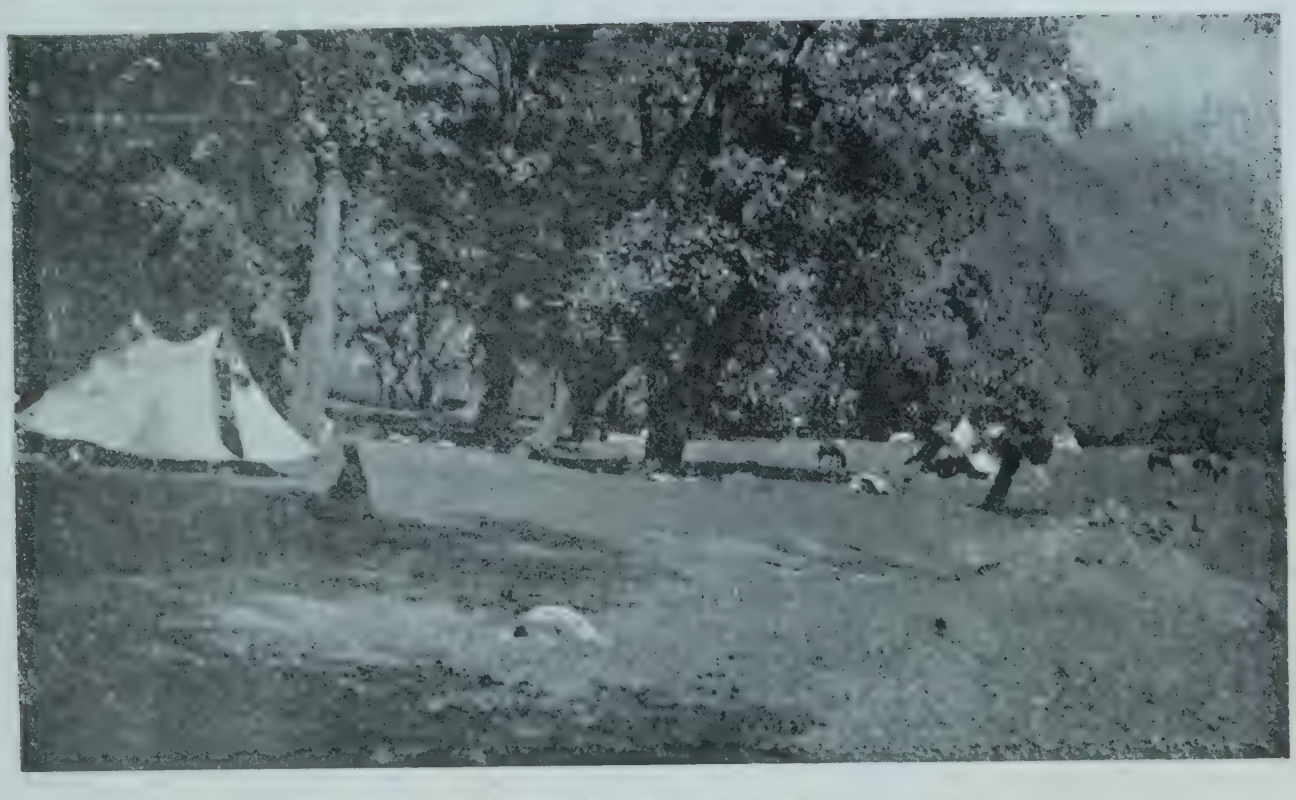
It was on the far side of the summit, that we met a man from the Lahoul side, who told us that there were three miles of snow in front of us, which were impassable for mules. Very soon after this the thaw started, and the mules began to flounder. However, by unloading them and dragging the baggage along the snow, we managed to force them on some way. But at last the animals became quite exhausted, and their knees were bleeding from repeated falls, so that we could neither move them towards Lahoul nor back towards Kulu. Moreover, the daily hurricane had just started. Accordingly we made for a refuge hut which had been built after a disaster some years ago, for travellers caught by a blizzard.

We found that this hut was packed with ice, so I decided to make for Koksar, the first village of Lahoul and get assistance. I only succeeded in producing four coolies, and returned to the top of the pass with these, to find that the foolish mule drivers had tried to continue the journey on their own, and could now neither get down the pass nor could they regain the refuge hut. The coolies took some of the baggage down and left some food for the mules and we did not get back to Koksar until after dark. There I was glad to get a meal, having eaten nothing since the previous evening except a chapatti and a cup of green tea, which a trader had kindly prepared for me during my first visit to Koksar.

At midnight I started up the pass again, having been assured by the headman at Koksar that he would send the coolies up after me. I managed to lose my way in the dark and did not reach the mules until daybreak. Needless to say, only two of the coolies arrived and it took us eight hours to get off the pass. This was at last achieved by tobogganing down the snow on the baggage and leading the mules down unloaded. At last, after crossing two difficult ice bridges, we reached Koksar.

We now had four very pleasant days along a rock road to Kyelang, the capital of Lahoul. The first of these I travelled with a Buddhist lama, with whom I conversed in broken Urdu. He was preceded by a woman, who carried a trident with which to drive away the devils. When we parted my lama gave me a turquoise ring with his blessing. On the third day we reached Gondla opposite a colossal precipice, which is said to rise 11,000 feet sheer above the bed of the river, with two glaciers at the top, portions of which are constantly breaking away and descending with a roar into the valley below.

It had been my intention to cross from Lahoul into Chamba by the Kukti Pass, which although 17,400 feet above sea level was five days shorter than any of the other routes. At Gondla I heard such discouraging stories about the state of this pass, that it seemed as if I would have to give up the idea. However, I determined to make further enquiries on my arrival at Kyelang ; and so, having crossed an easy 14,000 feet pass, from which I got a marvellous view of the Spiti mountains, I met my mules, which had been sent round by



1. NOMAD CAMPS ON BANKS OF BEAS, KULU.



2. THE RIVER BEAS BETWEEN SULTANPUR AND KATRAIN, KULU.



3. VALLEY OF THE CHENAB ON THE WAY TO KYELANG, NEAR SISSUE, OVER 10,000 FT. ABOVE SEA-LEVEL.



4. BRIDGE OF TWIGS (*Jhoola*) OVER THE CHENAB AT GOHBRUNG, LAHOUL. MY BEDDING IS SEEN CROSSING.

road to that metropolis. Here I met Thakar Abai Chand, Wazir of Lahoul, to whose kind assistance I owed the comfort of my return journey.

About 1,000 feet above Kyelang is the Sher-Shah monastery, which is the centre of Lahoul Buddhism, there being an exceptionally holy hill on the opposite side of the valley, a circuit of which is said to be an act of great merit. The only other monastery in the country is placed in the face of a cliff at Koksar. The great event of the year at the Sher-Shah monastery is the devil dance, which was due to take place two weeks after the day of my arrival. This festival is very interesting, as all the inhabitants from the surrounding country are present.

Lahoul Buddhism is somewhat influenced by Hindu beliefs, which is not surprising as many pilgrims pass through the country every year on the way to Trilognath, a notable Hindu centre in Chamba territory. There are still devil worshippers in the country.

In the winter 1924–1925 there was a certain amount of discord between the lamas and the laity; this was partly due to a particularly holy incarnation, who was resident in the valley at that time and who behaved in a manner not at all in accordance with his calling. It is even said that the chief lama of a distant monastery, upon his death bed, named as his own incarnation an unborn child, rather than have this man as his successor. As a result of this friction the lamas had lost much of their influence.

Another notable feature in the country are the Chummoos or nuns, who wear red gowns and have close cropped hair. They work in the fields during the summer months and only return to the monasteries during the winter. Two of these were employed by me as porters during my return journey; they were remarkably strong and very cheerful lasses. As a whole the women of Lahoul are of very powerful physique and walk with a long, easy, graceful stride. The lay women wear a peculiar silver ornament on their heads. The Lahouls are polyandrous and their women have considerable influence in the household.

The men are of comparatively smaller physical development, but the whole population are of Mongolian type and remarkably hardy, their chief affliction being cataract, which is probably due to snow blindness. Lahoul is completely cut off from the world during the winter months, in fact very little movement takes place in the valley itself at that time. The chief transport animal is the zho, a cross between a yak and a cow.

I now decided to visit Patseo and the Baralarcha Pass. Patseo lies some fifteen miles beyond the last human habitation in the valley of Lahoul, at an altitude of 12,000 feet. Each year the traders from Central Asia and Tibet meet the traders from India at this place, which is the lowest point to which the Tibetans, in their great fear of Indian heat, can be induced to carry their wares.

The fair at Patseo had not yet started owing to the state of the Baralarcha Pass, upon which a large caravan was then snowed up, and many ponies had died. However a great mixture of people had already arrived, including many representatives of that fine race of mountaineers the Gaddis, with their kilt-like smocks wound

round with a great length of rope and their great mushroom-like pugarees.

Beyond Patseo is the serai of Zing-Zing-bar from which the pass is crossed. After a long ascent over the snow-clad slopes and past the Suraj Dal Lake, noted for its weird beauty, the top is reached 16,000 feet above sea level.

Crossing the pass opens another new world, one of utter desolation. Even the 20,000 feet mountains are dwarfed by the tremendous mean altitude. There to the north, beyond the famous grazing grounds of the Lingti Plain, lies the road to Leh, and somewhere in the wilderness of snow to the west is Togpo Gogma, the first serai on the road to Spiti. Zasker can be reached by turning off at Darcha some fifteen miles on the Lahoul side of the pass.

To proceed in any direction over the Baralarcha ('cross road') Pass it is necessary to have a special permit. These are not difficult to get, but the expenses of travelling will be very great, as everything necessary for the journey must be taken from Lahoul, the country on all sides being devoid of life and vegetation. Spiti can also be reached by two other routes. The ruler of the country is called the Nono. He lives at Dankar. Bhurral can be shot in Spiti, *Ovis ammon* and bhurral in Ladak, ibex in Lahoul, though the average heads are much smaller than the Kashmir variety.

On my return to Kyelang, I got news that the Kukti Pass was now open and that the annual migration of flocks had begun. Each year vast herds are driven over the passes to the wonderful grazing grounds of the high Himalayas, returning again in the winter to the warmer valleys of the foothills.

I had made arrangements to go up the Billing Nullah, where I had hoped to shoot an ibex before returning, when I sprained my ankle, and was detained by this for the rest of my stay in Lahoul. My servant was fortunately a good masseur, and I was soon fit to travel with the aid of a tight bandage. By this time the monsoon had broken and as I feared the loosening of the boulders would prevent my reaching Chamba, I determined to set out at once.

As the road was impassable for anything else, I engaged foot coolies half of whom were men and the other half women, including the two nuns already mentioned. After a Sunday morning service, conducted in Tibetan, by Mr. Peters, the Moravian missionary, I followed the coolies along the beautiful banks of the Chenab, which were covered with wild roses, bluebells and other English flowers, and on the second day I reached the bridge of twigs at Johbrung.

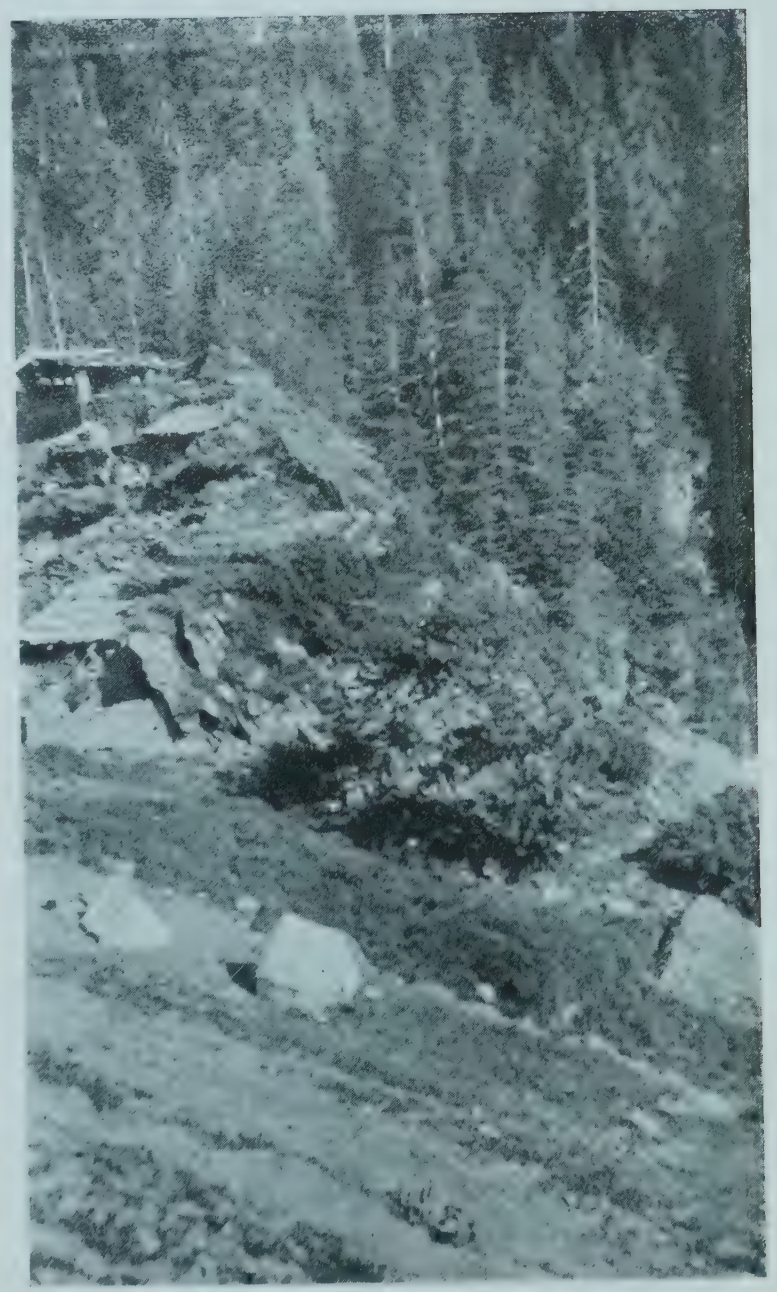
This bridge consisted of three ropes of interlaced twigs, to cross which you walked on the centre one and held the other two with your hands. Toward mid-stream the hand ropes got so far apart and so low that it necessitated a sort of tight rope performance to get along at all. Also the whole bridge was swinging and if you looked down at the torrent below, severe sea sickness was the result. A good yard from the end the foot rope stopped altogether and a long stride had to be made from an insecure footing to reach *terra firma*. After I had crossed with three of the men, I got news that the women had laid down the baggage on the opposite side



5. OLD CASTLE OF THE THAKARS OF LAHOUL, GONDLA.



6. MT. GARPANG (19,900 FT.) FROM SISSUE. VISIBLE FROM SIMLA ON A CLEAR DAY.



7. MY CAMP AT KUKTI, CHAMBA STATE



8. MOUNTAINS OF PIR PANJAL RANGE OVERLOOKING CHENAB, WITH GLACIER OF MT. SHIKAR BEH, 20,340 FT.

and refused to go further down. So it was necessary to get recruits from Johbrung, and even when all the baggage was across the women refused to come for their money, which had to be sent back to them.

The next day with a new train, which included the headman of Johbrung, I started the ascent of the pass. We only covered six miles on this day, camping low so as to be clear of the avalanches. On the following day we had to remain in camp owing to a storm on the pass above us. Mindful of lessons learnt on the Rohtung Pass, I started at midnight. This caused much pain and sorrow to the coolies, as the going was not nearly so good as on the other pass.

Presently we reached the snow line, and ascended a steep tongue of snow in two parties. Those in front would shout *Om mani padmi hom*, at about every hundred yards and this was re-echoed by the party behind, to be taken up again at regular intervals. As we neared the top, the ascent became steeper, and as a late fall of snow had covered the ice, it was very hard to get a decent foothold. Fortunately I was wearing the grass shoes of the country, and I believe that I could never have proceeded in ammunition boots. We were relieved to reach rock again as we could cross this at a better speed. The headman and I, who were leading were busy cutting steps across the ice at the top, when the first coolie disturbed a large boulder which came bouncing down on the top of the rest, like an overgrown football. I have never seen men take cover so quickly, but a shepherd who was with us moved just too late and had his shoulder smashed. The only woman coolie lost her footing and went down several hundred feet. Fortunately she fell into a snow drift, and when we got her up again she was able to continue the journey.

Now that the top was reached we called a halt, and after the shepherd had been attended to as well as possible and sent back, a sheep was sacrificed to the accompaniment of much horn blowing and bell ringing.

Soon, gathering clouds and a slight sleet warned us that we should be moving. Accordingly we began the descent to the glacier over a sheer drop of ice-covered rock. This was very slippery and we proceeded with great caution sometimes even hand in hand. Here my bearer was delighted to find some crystals. The glacier presented no difficulties as the crevasses had not yet fully opened. The danger being that once these have opened and been covered with a light fall of snow, they are invisible until trodden over. We now had an easy climb down the rest of the pass and camped at 4 p.m. in a cave well clear of the rolling boulders. The altitude of 17,400 feet had given me a severe headache and I was glad to turn in.

On the next day we reached Kukti, the first village in Chamba. In this state I had expected transport difficulties, as everything had to be arranged from the wrong end. But thanks to the kindness of H. H. the Raja, I was met by the headman of each village about a mile before reaching it and was supplied with everything I required.

From Kukti I had two very trying marches down a gorge. The track, after passing through a splendid pine forest, narrowed

considerably as it crossed the face of the cliff and then, widening again crossed the Saralla Pass, and so after six days to Chamba town. The monsoon had by this time started in earnest, but after the first two marches there were always good rest houses in which to get dry after the day's march. From Chamba it is only two short marches past the beautiful valley of Kajiar to the cantonment of Dalhousie.

Chamba State suffers from a peculiar disadvantage of being divided in half during the winter months, as a snow range cuts off the whole of the northern area. All shooting and transport regulations can be had on application to the Secretary to H. H. the Raja. Of all the parties which were shooting in this state during the early part of the year, I did not hear of one which returned empty-handed. The inhabitants at Chamba are somewhat mixed in race and are strict Hindus.

The whole journey of over four hundred miles cost me just as many rupees, exclusive of stores bought at Delhi. These included a medicine chest, a very necessary item, for the inhabitants look upon every white man as a qualified doctor, and though I practised to some extent, I fear that I was a very sorry quack.

PRINCIPLES AND EXTENT OF THE EDUCATIONAL SERVICE RENDERED TO THE SCHOOLS BY MUSEUMS IN AMERICA

BY

S. H. Prater, C.M.Z.S.

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(With four plates)

Perhaps the most impressive phase of museum activity in America is the work done by these institutions for the public schools. The Museum has become a vital factor in the educational life of the people and this ideal of service has developed and is developing so rapidly, that, with new facilities and a fuller comprehension of the scope of museum responsibility, the museums of the country will become to an even greater degree one of the leading agencies for the cultural development of the nation.

The main principle which governs the teaching service the museum offers to the schools is that this teaching should not add to the work of the school teacher, but on the contrary, should be planned to assist him in the work he actually has to do. It should not add to his burden but is intended to lighten it both by affording him such information as will simplify his task and by giving him greater facilities for conveying this information to his pupils. In short the museum's teaching service does not add to the school curriculum but conforms to it—this is the secret of its success—success which can only be achieved by the closest co-operation between the museum and the educational department. Every phase of museum instruction to be successful must be the result of experiment and discussion between the museum authorities and the schools, and the growth and development of this service, if it is to be effective, must follow the helpful suggestions of school teachers who have previously associated themselves with museum educational work.

Extra-Mural Service

In America the scope of the museum's service has not been confined to assisting the teacher in the museum galleries but is extended to afford him facilities for instruction in the class room. This is effected by placing at his disposal information which will be of service to him in the teaching of various subjects prescribed by the school syllabus, in the shape of lantern slides, prepared lectures, and special exhibits and also by sending museum lecturers to the schools to assist the teacher and to simplify the work he has to do.

Lantern Slides and Lectures

The lectures and the slides illustrating them cover a wide range of subjects dealing with History, Geography, Hygiene, English Literature, Domestic Science, Nature Study and High School Biology: in brief, the subjects selected conform to the courses of

study prescribed for the schools. The effectiveness of this 'visual instruction' which the museum is in a position to offer to the school can be readily recognized. We are most of us visual minded, anything that has been presented to the eye has the best chance of being retained and recalled. By putting an idea into visual form we increase its power both by the swiftness and clarity with which it is received and the ease by which it is recalled. Visual instruction, by bringing the pupils in visual, and therefore more graphic, contact with the subjects about which they are learning, helps to drive the lesson home and simplifies the task of the teacher. The object of the museum's lecture service is a means to an end—not the end. Its object is to plant the seeds of desire for knowledge, to suggest to the children many interesting things that lie about them, to give them some idea of the cities they live in, to interest them in the world without, both animate and inanimate, to plant in them ideals of good citizenship, to help them to realize what the public institutions of the city are doing for them and the duties they owe to those institutions; in fine it aims at giving the child a saner outlook and a better understanding of life, its principles and relationships.

Some idea of the magnitude of the service rendered in this manner by various museums in the country to the schools can be arrived at by a study of the figures. In New York city the lectures and slides placed at the disposal of the schools by the American Museum of Natural History reach over 50,000 children annually. In 1915 40,000 slides were issued by this museum to the public schools, while in 1926 the number rose to 726,028. The material is delivered to the schools by a fast messenger service and the American Museum maintains a fleet of 4 motor trucks and motor cycles for this purpose. At Buffalo between 1925 and 1926 a total of 113,776 slides in 3,346 sets were loaned to the public schools. The service is also extended to private schools and institutions. In Buffalo the loan service is extended to the general public. The museum maintains, in addition to a stock of slides and lectures, a set of lanterns which may be borrowed by private individuals wishing to use them. The extent of this service may be gauged from a passage in the report of the Buffalo Society of Natural Sciences which indicates that a total of 1,941,827 or nearly 2 million slides were issued by the museum to the educational Institutions and to the general public during the 7 years the department was in operation.

Lectures in the Schools

The second method of extra-mural service adopted by museums is the system bywhich lecturers, attached to the museum staff by the Board of Education, visit the schools during class hours and deliver a definite and systematic programne of lectures covering both school terms.

A word about the museum lecture. Dr. Fisher, Curator of Education at the American Museum of Natural History, in speaking to me about museum lectures said 'It requires a special type of lecturer to handle and interest an audience of school children as it

does to handle an audience of adults. The best lecturers are born not made, others achieve the art through training and experience. Though many of our lecturers are university men, the ablest men are quite often found amongst those who have not had the advantage of a university career.'

The subject matter of the lectures, selected by the museum for delivery in the schools, is again entirely correlated with the courses prescribed by the Board of Education, for use in schools. The advantage of the system is that it affords facilities for instruction which the schools would not ordinarily have—and which a museum is well able to provide, that it enables a larger number of schools to benefit by the museum's educational work and thus permits the museum to extend largely its sphere of utility. In 1925, more than 200 schools in Cleveland were visited by the museum lecturers and the museum was thus able to be of service to more than 60,000 children. At the Field Museum, Chicago, the school extension service covered 259 schools with an attendance of 96,158 children.

Circulating Collections

The third method by which a museum can increase its utility as a medium of popular education is by sending properly prepared exhibits to schools where they become a medium of instruction.

A museum cannot perform its full mission for the welfare of school children by merely maintaining its galleries, however well they may be equipped, and inviting the school children to visit them. Whatever pains and trouble the museum authorities may be put to in their endeavours to induce the school children to visit their institution, it will generally be found, especially in the larger cities, that the number of children who actually visit the museum is small in comparison with those attending the schools. The system of circulating suitable material from their collections to aid in the teaching in the schools is therefore generally adopted by museums in America as a direct method of increasing the scope of their educational work. These circulating collections are made available to the schools day after day, month after month, thus becoming an influence in the lives of thousands to whom the museum might otherwise have been a stranger. This direct method of effectively associating the museum with the schools is in harmony with the views and desires of progressive school teachers, who realize that the method not only adds to the reality of the teaching but becomes an aid to a better understanding of the subject taught. thereby lightening the task both for the teacher and the pupil. In general the cases are designed to show the pupils examples of local animal and plant life. The exhibits are usually mounted in natural surroundings with painted or photographic backgrounds, showing the environment in which they are found. Besides natural history specimens, the circulating collections also include exhibits illustrating industrial and commercial products and the methods of their manufacture, etc. The subjects selected being products that are in daily use or observation by the child.

The educational value of these exhibits lies mainly in their realism. I append a series of photographs showing exhibits

circulated among the schools by the Field Museum, Chicago and by the American Museum of Natural History, New York. The photos illustrate the different methods employed in the treatment of these exhibits.

In addition to the public schools these circulating collections are also loaned to various public institutions such as public libraries, art institutes, Y.M.C.A., etc. The libraries co-operate by having on hand books relative to the subject of the display. The direct influence of these exhibits is to stimulate a desire for knowledge of the subject on the part of users of the library and it results in the more extensive use of educational literature.

The report of the Field Museum, Chicago, for 1925–26, shows that the total number of cases prepared for the use of schools is 908, of this number 706 were in daily circulation and 353 schools benefited by the scheme. It is estimated that nearly ½ million pupils had the opportunity, every day of the school year, of studying two of these cases and as the cases are changed at regular intervals, thirty-six different cases were placed at the disposal of each school during the period under review. It will be seen that the system makes it possible for the museum to reach a large number of pupils than it could otherwise have reached and, besides providing pleasurable instruction, it creates a greater interest and a greater appreciation of nature; it increases the friends and frequenters of the museum and rouses in them a spirit of enquiry and a keener desire to make use of the many advantages the museum affords.

Circulating collections offer greater advantages than permanent loan collections. The latter are apt to deteriorate, and being permanent objects in a class room, the interest they occasion is apt to wane. Circulating collections are better looked after, they cover a wider field and the interest in them is constantly renewed. Damage to the specimens occasionally occurs, but no great heed is paid to this, mainly to encourage the teachers to take and make use of them.

I have tried to indicate the principles that govern the educational work carried on by the museums of America outside the walls of the museum and to give an idea of the extent and magnitude of this extra-mural service. In the great cities not everyone, and particularly the little ones, can go to the museum but the museum can go to them and by means of its stores of slides and lectures placed at the disposal of the school teacher, by its direct lecture service in the schools and by its circulating collections it can become a direct influence in the lives of thousands it might otherwise never have reached. The benefit the children derive from such a logical and intimate connection between the museum and the schools can readily be realized; its influence goes beyond the mere teaching of natural history, for every agency which directly increases the attractiveness of knowledge and the ease of acquiring it becomes an agency for national culture, for better citizenship, and for greater stability in civic conditions. And therein after all lies the secret of what we, as human beings, are after. We make life increasingly successful as we are able to minimize the time spent on certain tasks in order that our energies may be released for other worthwhile tasks and opportunities.



By courtesy *American Museum of Nat. Hist., New York.*

CIRCULATING NATURE STUDY COLLECTIONS.



By courtesy *American Museum of Natural Hist., New York.*

AN EXAMPLE OF A CIRCULATING COLLECTION CASE.

Services within the Museum

So much for the extra-mural service of museums in America, I will now pass to a review of the principles and systems in use for carrying out educational work within the walls of the museum. The teaching offered by the museum in its galleries must follow the lines of the work it conducts directly in the schools. Here again the system demands the closest co-operation between the museum authorities and the teaching staff in the schools. We must look to the teacher for guidance both in the selection of our subject and the method of presenting it. The type of visual instruction the museum offers is comparatively new and museum instruction has not arrived at that degree of science reached in school instruction. The school instructor instructs chiefly through words, and uses pictures to illustrate his word-formed ideas. The museum teacher instructs chiefly through objects, and uses words to develop in his pupils ideas formed through a study of these objects; but all museum instructors must labour under the disadvantage of having been themselves educated mainly through verbal instruction. Till the visual instruction offered by museums, by experiment and practice, can be made to attain its fullest effect so long will it be dependent for guidance and inspiration on the methods of instruction used in the schools. It should be remembered that all educational work is largely experimental; it is useless to formulate a fixed policy, the system must be elastic and the methods employed must be discussed from time to time with people who have actual experience in education in order that a true judgment might be formed as to the measure of its effectiveness.

Teachers' Guides

One of the methods by which the exhibits in the museum galleries are brought into the service of the school teacher is revealed by the system in vogue at the Field Museum, Chicago. The Museum has prepared a leaflet which gives an outline of the public school syllabus and shows the correlation between the courses laid down for study in the schools and exhibits in the museum galleries. The leaflet covers History, Geography, Natural Science and Manual Arts. The teachers are thus made conversant with the material in the museum galleries which will directly assist in the teaching in the schools. This classification of museum material places the museum collections more effectively at the service of the schools. A teacher is able to select his subject and bring his class for instruction to the gallery where this subject is illustrated.

Museum Lectures

Apart from lectures to the pupils in the galleries, the majority of the museums provide a regular lecture hall or auditorium where a systematic programme of lectures is delivered to school children. An idea of the scope of the museum lecture service to the schools is obtainable from a study of the numbers of school children attending these lectures at the various museums.

In New York over 30,000 pupils from the local schools attend the lectures annually.

At the Cleveland Museum of Natural History in 1925–1926, 831 classes were held for schools in the museum which were attended by 27,557 children; while at the Field Museum, Chicago, 348 lectures were given last year, with an attendance of 11,821 children.

In selecting the subject matter for the lecture it is essential that the lesson should have a definite aim, the object of the lesson is not to make a scientist out of the child but it aims at instruction in 'the art of life'; at affording both food and training for the mind. This cannot be done by marshalling whole series of facts—these will soon be forgotten but the principles governing these facts will remain—the teacher must keep in mind the principle and select the best medium by which he can develop his subject and drive his lesson home. Take for example the principle that life is absolutely dependent on food. We can broaden the child's concept of this principle by showing how the structure of an animal is adapted to the conditions and manner by which it obtains its food. A lesson on adaptations in Nature is indicated. Can the subject be best taught and illustrated to children through the medium of a lecture on mammals? If so, we might develop the theme as follows:—

I. A review of the various types of vertebrate animals.

II. A discussion of the importance of food to all forms of life.

III. Grouping of mammals according to food—Carnivorous, Herbivorous, etc.

IV. Examination by the class of the teeth of each of these groups of mammals.

V. Study of the feet of these animals.

VI. Summarize the lesson and draw conclusions how these various animals are adapted to fit into their environment and to obtain the food they require.

Museum Examination Courses and Games

An important feature of the lecture is that the teacher should be able to judge its effect on the class. At the American Museum of Natural History examinations are held for the children at the museum. A series of printed questions is prepared, the answers to which are to be found not in the text books but in the exhibits and their labels in the Museum galleries.

At the Cleveland Museum the lectures are concluded by what is known as a 'Museum game.' The pupils are given a printed card of questions which bear reference to the subject matter of the lecture. A definite time is set for answering the questions at the end of which the percentage of correct answers obtained is recorded.

The museum is thus able to judge the efficiency and influence of its teaching. At Cleveland the children attending the schools are subjected to an intelligence test and the pupils in the various classes are divided accordingly i.e. an 'X' class would mean children of high intelligence, 'Y' class less intelligent and 'Z' dull children. It necessarily follows that the lectures at the museum and the games that follow must be suited to the grade of children attending them.

An 'X' class of children was given problems of its own to work out. A clever child will jump at an answer and if his mind is not given something to worry him further he will quickly lose interest. So the idea was to give them something difficult which would take sometime worrying out, to leave them at it and to keep them at work. The less intelligent children were treated quite differently, they were given simpler tasks and told to take plenty of time over them and encouraged to find out the answers themselves, made to try again and again and only helped when necessary. The success which met their own unaided efforts gave the children a new confidence in themselves and had a remarkable effect on their outlook. The value of these museum courses is that they force the child into independent enquiry for the information he or she desires. Their object is to help the pupil by permitting him to work independently and by inducing him to find out things for himself, and to the naturally curious and inquisitive mind of the child this method of instruction is both attractive and effective.

Work for the Scouts

Apart from their work with the schools the museums in America take a deep interest in the field of activity offered by the Scout organizations. At the Brooklyn Museum and at other museums a special Scout instructor is retained on the staff of the museum and a branch of the museum is generally established at the Scout training camps. The museum spirit is even carried out of doors by the establishing of what are known as 'trail museums'. A certain trail or path through a forest is treated as a museum. The trail is divided into two sections the 'training trail' and the 'testing trail'. In the 'training trail' chatty labels and classical quotations draw attention to the objects of interest to be seen on the way. The 'training trail' leads to the 'testing trail' where the labels take the form of a series of questions. The visitor walks through the 'training trail' and then answers the questions in the 'testing trail'. Contests were held by this means between different troops of scouts.

Finally the musuem helps the scout in carrying out his nature tests and obtaining his merit badges. Special demonstrations are also held at the museum for local troops. The programme of entertainment on these occasions is made up of Nature talks, motion pictures, etc., in short the museum is able to offer the scout wholesome and instructive entertainment and amusement.

Work for the Blind

The last and perhaps most sympathetic feature of Museum educational activity in America is the work done for the blind, and the crippled. One of my photographs shows a class held at the American Museum of Natural History for blind children. The method adopted is to give a lecture to the blind pupils and to illustrate it by something which they can handle, and feel. The plate illustrates special exhibits suitable for study by blind children. The specimens are arranged on trays and placed at the disposal of

the class who are thus able to study and handle them. A lecture by Commander Peary, the discoverer of the North Pole, given especially for blind children, was illustrated by a raised map of the Polar region, showing the route taken by the expedition, and by the actual sleigh used on the trip which was equipped with its full complement of dogs and with its driver in Polar costume. The audience was first permitted to examine the exhibits, they then heard the lecture after which they re-examined the material with greater interest.

I have endeavoured to review the principles and the extent of the service rendered by museums to the cause of popular education in America. They are essentially museums for the people, seeking every channel of activity whereby their sphere of usefulness might be increased, entering into every sphere of the people's lives and working with all the resources in their power for their people's betterment and uplift. One cannot help but realize that the museum in America has developed and is developing into a great and powerful instrument for moral and spiritual development; it is to be reckoned among those great civilizing influences that are helping man to a broader understanding of life, to an appreciation of its interest and its beauty and to that conception which engenders the spirit of love to all things created. The great religons of the world are doing that, the great writers, poets and painters have done that and the museums are endeavouring to follow in their wake by an ably organized, definitely controlled and far reaching system of service to the people.

I have submitted for consideration of the committee detailed working plans showing how the various systems outlined in the above report are made to operate—unfortunately space does not permit of their being included here. I will therefore pass to the recommendations as to methods we should employ in establishing a service for the schools in our own museum.

Recommendations

Before making my recommendations on the lines we should follow in establishing an efficient educational service it would perhaps be as well to study the methods employed by one of the museums preparatory to launching its educational programme.

The educational service rendered to the city of Cleveland by the Cleveland Museum was built up gradually. The museum authorities, having a desire to take up a programme of educational work among the schools, worked on a system which had for its policy the idea that the schools themselves should say what they required and the museum would do its best to meet them. They had to feel their way : it was no use drawing up a definite programme and forcing it upon the teachers ; such a policy, they believed, would end in failure or, at best, obtain very limited support. It is difficult to force a new system on to teachers and useless to dictate to people who have no, or perhaps very little, interest in the programme you have to offer. The first essential to success is to make the teachers understand that you are not proposing to add to their work by forcing on them new subjects but that you are out to help



By courtesy *American Museum of Natural Hist., New York.*

EXHIBITS FOR THE BLIND.



By courtesy *American Museum of Nat. Hist., New York.*

BLIND CHILDREN STUDYING THE HIPPOPOTAMUS.

them by simplifying for them the teaching of subjects they are actually engaged in.

The Curator of the Cleveland Museum first held at the museum a very informal meeting for teachers and principals of the local school at which meeting he outlined his programme and told them what he had to offer; he then asked their advice as to the methods by which he could best co-operate with them. To awaken their interest still further a preliminary lecture was given to the teachers and principals in the local schools. It was a purely informal affair which concluded in the cordial atmosphere produced by tea and light refreshments. After the lecture suggestions came from the teachers that the same lecture, in a modified form, might be given in their own schools; requests came from so many schools that the curator was no longer able to cope with the work. A special lecturer was then appointed from the regular staff of the education department to take over the work. The system grew and in a year or two they had two lecturers who visited each school in the city at least twice during each term. This led to the forming of a very definite and systematic service of lectures at the schools whereby more than 200 schools in the city were visited and the museum reached some 60,000 children. As the lectures were illustrated either with museum material or with photos of museum material, naturally a new interest in the museum was created which resulted in a desire on the part of the teachers to visit the museum and bring their classes there. This led to classes for children being held at the museum. The lecture service at the museum thus grew up normally; it was not forced and there was nothing compulsory about it. This system of classes at the museum was started in a small way, the schools telephoning for an appointment or writing; gradually a considerable proportion of the local schools commenced to avail themselves of the service the museum offered and it became necessary to draw up a regular schedule whereby four classes were held for each school during the year, i.e. two classes during each term. More schools came into the scheme till in 1925-26, 831 classes were held at the museum attended by 27,577 children. As the system grew two lecturers were appointed to the museum staff who lectured alternately to the children each giving three lectures per day. This briefly explains how the museum's school extension service was established and placed on a firm footing.

Now a consideration of the policy and methods employed by museums in America in their educational work for the schools reveals the main principle that all such service should be correlated to the courses of study prescribed for the schools by the Board of Education, that the service should not add to the burden of the school teacher but should assist him, and that the development and growth of this service is dependent on a natural desire on the part of the school teacher to make use of the opportunities and advantages the museum offers him.

The first step would be therefore to consider, by a study of the syllabus prescribed by the Education Department for the use of Primary and Secondary schools, the ways and means by which the

teaching service the museum proposes to offer can be correlated with and be made to conform to the courses of study laid down by the department.

The points for consideration would be whether the different sections of the museum can obtain and supply information that would be directly helpful to the teacher in the teaching of such subjects as History, Geography, Nature Study, Civics, Hygiene, etc.

Can the Art and Archæological sections help in the teaching of History by making available for the use of teachers in the local schools an outline of the exhibits in their collections which would be directly helpful in the teaching of this subject and by supplying information in the shape of lectures and lantern slides relative to, let us say, places of historical interest in the city of Bombay, historical monuments in India, the Moghul period, the Peshwa dynasty, etc. ?

Can the Natural History Section help in the teaching of such a subject as Geography by supplying information through its exhibits and by lectures relative to the natural resources, and industries of the country ? i. e. Rice-growing, Wheat, Tea, Coffee,Forestry, Coal mining, Cotton and Cotton manufacture, Fisheries, Iron and Steel, etc. How far and by what methods can it co-operate in the teaching of Nature Study and High School Biology ? As regards Geography very little can be done at the present time as the space at our disposal in the museum is inadequate for the development of such sections as would particularly lend themselves to the task ; but as regards Nature Study and Biology much may be achieved.

Can the Museum help the schools by offering information on what the great Public Departments of Government and the Municipality are doing for the welfare of the country and the people in the city ?

Our programme of work, whatever it is, can only be effectively arranged by consultation with the educational authorities who should be in the best position to advise the museum as to the lines on which it should proceed. It is recommended therefore as a preliminary that this report should be circulated for opinion and advice among those who would best be able to offer it. A meeting could then be arranged at which the proposals put forward could be further discussed.

The next step would be to awaken the interest of the schools, by holding a special entertainment (I purposely call it entertainment because the gathering should be perfectly informal and conclude with refreshments) for the principals and teachers of the local schools where we could tell them briefly how we propose to help them. A lecture on the work of museums in America might serve as an introductory eye-opener.

The lines on which we could help are as follows :—

School Catalogue of Museum Exhibits

The preparation by each section of the museum an outline of the exhibits in its galleries which could be of direct assistance to the

teacher in the teaching of various subjects prescribed in the curriculum for Secondary schools. From this outline the teachers would be able to know exactly what exhibits in the museum would be helpful in the teaching of a particular subject and could arrange with the museum for a class to see them under the guidance of the Curator or his assistants.

Lectures to Classes at the Museum

The preliminary lecture should always take the form of a conducted tour through all the galleries of the section, as, before interesting a child in a particular part of the museum, it would be necessary to satisfy his curiosity as to the contents of the museum as a whole. The ultimate aim of the guide lecturer should be to prepare a specific programme of lectures which should follow as far as possible the courses of study laid down in the school syllabus. This programme should be available for circulation among the schools at the commencement of each term. While this is in preparation classes might be held in the museum with the object of interesting the children in local forms of animal and plant life and other material the museum contains. These talks could be illustrated with museum material and should be given to the children in the lecture room. But in developing his programme of lectures the lecturer should remember that his objective is to establish a sympathetic relationship between the children and their environment viz. the city child's relationship with the world in which he lives. Subjects which concern the health, habits of life, the skill, intelligence, building, food getting, and other activities of man are as of vital interest to the child as the study of the lower forms of animal life. The schedule of lectures should be so arranged so as to give pupils from each school the opportunity of attending them at definite intervals during the school second term. During the present year while these classes are being held and the interest of the schools in the projects is being roused, work might continue on the preparation of a definite programme of lectures which should be ready for circulation among the schools at the commencement of the school term in 1928. In the preparation of this programme the lecture programmes of various American museums which are available might be studied with benefit. The guide lecturer will go through a list of the schools who are co-operating in the scheme, he will give each school certain hours and dates at which lectures can be arranged for. The principal of the school will receive this notice specifying the time and the dates at which his classes could be accommodated and will signify his approval or suggest a change. The lecturer will thus know what his programme of lectures is to be, the time and the dates and the number of pupils he can expect.

Museum Courses

When the system of lectures has been developed sufficiently a commencement might be made with museum examination courses,

when sets of printed questions might be given to the pupils, the answers to which are to be arrived at by examination of museum material exhibited in a particular gallery. The examinations should be conducted as in a class room and attendance should be compulsory. A prize might be offered to the pupil obtaining the highest percentage of marks, or classes from various schools might compete.

Museum games, as described in the body of this report, might also be held at the close of the lectures as a valuable method of judging the efficiency of the teaching and giving good brain-stretching exercise to the child.

Museum entertainment

We should consider the possibility of holding at the museum during the year one or two entertainments to which as large a number of children from the local schools as possible should be invited. The programme should be made up of motion pictures of educational interest, i.e. travel films, nature and health films, etc. (I feel certain that the local firm of Pathe Freres would help if properly approached. The Haffkine Institute also has some suitable films and I believe the Railway companies also have suitable films of travel in India which they might possibly loan). Lantern lectures and nature talks could help to fill the programme.

Extra-Mural Service

As I have already stated, a very important phase of the museum's extra-mural service is the providing of lantern slides, and lectures for the use of teachers in the schools. We should endeavour therefore, while developing our lecture service in the museum galleries gradually to amass the material for this purpose.

The cheapest way would be for the museum to prepare its own slides by engaging a photographer and giving him the material and the facilities for carrying out this work. A large amount of material could probably be collected by appealing to various public departments, railway and transport companies, and commercial and industrial concerns. The American Museum built up a large proportion of its stock of slides in this manner. As the museum was offering publicity to these organizations in the work it proposed to do there was a natural desire to co-operate on the part of those to whom the museum appealed. Lastly a number of slides might be obtained through exchange. The American museums are anxious to obtain Indian material for their collections. Specimens illustrative of American animal life which they would normally give us in exchange would not be of much use to us as our sphere is limited at present to the Oriental Region but they could and are willing to help by supplying us with material from their Education Department. A glance through their catalogue of slides will show how many of the subjects covered would be directly applicable to our own use. After consultation with the Director, I am able to state that the

American Museum, New York, would be glad to enter into this system of exchange which would be mutually helpful.

In collecting the material a definite policy should be adopted, viz., that the subjects selected should have a direct bearing and relation to the teaching in the schools. In the appendix to this report which I am unable to publish here, I have endeavoured to indicate the lines on which we should collect our slide material, I have grouped them under subject headings, and have tried to show the possible sources of supply.

I have already indicated the various methods adopted for cataloguing and storing these slides but this is a matter which can be more fully considered when we have amassed a sufficiency of material.

Lectures delivered by the Museum Lecturer in the Schools

The advantages of this method, which enables the museum considerably to extend its sphere of utility and to reach a far larger number of pupils than it would by its normal lecture service in the galleries, need not be stressed. We could perhaps commence by setting aside one day in the week on which our lecturer could visit say three schools, the next week three others could be visited. We would by this means be able to take in a large percentage of the schools. The system would have the direct effect of increasing the interest of the schools in the museum and would also have a good effect on our lecture service in the galleries. I recommend a trial of the system and the formation of a programme of work suitable to conditions in the city.

Circulating Collections

The formation of suitable exhibits for circulation among the schools is purely a question of funds. I propose during the year to prepare one or two cases suitable for this purpose, as an experiment. At the Field Museum the whole cost of preparing these cases was covered by a single donation. At the Brooklyn Museum the circulating collections for the schools were established and financed by the Women's League, an organization similar to our Bombay Women's Council. Here is a field of activity which might be offered to the local Women's Council by which they could actively co-operate in the education of the children of the city. It is possibly a source from which we might obtain assistance and is worth trying.

The Museum and the Scout Organizations

The Boy Scout and Girl Guide organizations in Bombay present a very suitable field for our activities and it is recommended that the passages in this report which have reference to the work done by museums in America and thes organizations be forwarded to those who have control of the movement in Bombay. A meeting might

then be arranged at which we might formulate plans by which we could co-operate with the scouts both in the museum and in the training camps. The holding of classes and demonstrations for Boy Scouts and Girl Guides at the museum and the methods by which we could help at the training camps are points which might be considered.

Work for the Blind

Finally we should consider the possibility of holding at least once or twice during the year a class for the children from the local blind school. Examples of corals, shells, mounted birds, mammals and reptiles might easily be arranged in trays so that the children could handle them. They would then be given a talk on these specimens and then be allowed to re-examine them. It would be a means of bringing pleasure into their otherwise colourless lives.

INDIAN DRAGONFLIES

BY

LT.-COL. F. C. FRASER, I.M.S., F.E.S.

Part XXVII

(With one Text-figure and four plates)

(Continued from page 889 of Vol. XXXI)

Suborder—ZYGOPTERA

Head transversely elongate; eyes more or less widely separated, usually more so than in genus *Gomphus*; vesicle usually absent, ocelli lying free in middle of vertex; labium with middle and lateral lobes approximately equal, the midlobe deeply fissured; wings usually identical in shape, the hind dilated occasionally at their middles, never at the base: trigones represented by a foursided, irregular structure (hereafter called the *discoidal cell*), which may be squared, or obtusely or acutely pointed outwardly; pterostigma usually present, occasionally absent in one or all wings, variably shaped; antenodal nervures numerous or reduced to the two primitive pairs; wings usually held closed together when at rest; a pair of superior anal appendages at end of 10th abdominal segment, and a pair of inferior anal appendages at sides of anal orifice; female with well-developed ovipositor somewhat similar to that of *Gynacantha*.

Larvæ variably shaped, possessing caudal gills, two to three in number which show a great variety in shape and size, spine-like, vesiculated or padddle-shaped; breeding in still or running water, more often in the latter.

[Since this series of papers was started in 1918, our ideas on the venation of a dragonfly's wing has undergone very radical changes, and this the result of the finding of several most important fossil dragonfly wings which throw a flood of light on the problem. We now find that instead of a many branched medius, we have a many branched radius, and that the vein we have known as *Cui* is really *Cuii*, the former being absent in living Odonates, and further that the vein we have been accustomed to regard as *Cuii* is in reality *IA*. We are indebted to Lameere and Dr. R. J. Tillyard for this interpretation, and as it now brings the dragonfly venation into line with other orders of insects, and is certain to be generally adopted in the future, I propose to take the opportunity offered by the introduction of a new suborder, to introduce the new nomenclature.

The following table and figure will assist the reader in rearranging his ideas on the venation and will be amplified from time to time.]

New Notation (Tillyard's)		Old Notation (Needham-Comstock)	
Costa	C.	Costa	C.
Subcosta	Sc.	Subcosta	Sc.
Radio-median	R + M.	Radio-median ...	R+M.
First Radius (main stem) ...	Ri.	Radius	Ri.
Arc.	Arc.	Arc	Arc.
Second Radius (first branch).	Rii.	First branch of median ...	Mi.
Intercalated branch of *Rii* ...	IRii.	First intercalated branch of median	Mia.
Third Radius (second branch)	Riii.	Second branch of median	Mii.
Intercalated branch of *Riii* ...	IRiii.	Subnodal sector ...	Rs.
Fourth and fifth Radius combined	Riv + v.	Third branch of median.	Miii.
Anterior median (medius ant.)	MA.	Fourth branch of median.	Miv.
Posterior median (medius post.)	MP.	Absent in all dragonflies.	

New Notation (Tillyard's)			Old Notation (Needham-Comstock).		
First cubital nervure	...	Cui.	(Absent in all dragonflies)		
Second cubital nervure	..	Cuii.	First cubital nervure	...	Cui.
First Anal nervure	...	IA.	Second cubital nervure	...	Cuii.
Cubito-anal nervure	...	Cuii + IA.	Cubital nervure	...	Cu.
Second Anal nervure	...	A′.	Postcostal nervure	...	A.

The *Zygoptera* are divided up into two large families distinguished by the number of antenodal nervures, as follows :—

1. Only two antenodal nervures : discoidal cell usually entire ; arc midway between base of wing and node, or nearer node than base ; usually small insects.

Cœnagrionidæ.

2. More than two antenodal nervures, never less than five ; discoidal cell usually traversed but sometimes entire ; arc nearer base of wing than node ; larger insects.

Agrionidæ.

The *Agrionidæ* are divided up into three large sub-families as follows :—

1. Sectors of arc arising from the lower third of arc ; discoidal cell convex coastalwards and as long as or nearly as long as the basal space ; pterostigma often absent in both sexes, or much reduced or false in character.

Agrionidæ.

2. Sectors of arising from the middle or above the middle of arc ; discoidal cell rarely convex costalwards and shorter than basal space ; pterostigma elongate and well developed in both sexes.

Epallaginæ.

3. Wing characters same as last, but male sometimes with the pterostigma occasionally absent in forewing ; abdomen much shorter than wings ; epistome (or nose) enormously developed so as to form a tumid nasal structure on the front of face.

Libellaginæ.

Subfamily—LIBELLAGINÆ, Laid.



Fig. 1.—*Rhinocypha spuria*, Selys, male
Mt.=Mesothoracic triangle

Head robust, triangular ; eyes oval, large, projecting posteriorly, moderately separated from one another ; frons horizontal, rather longer than broad ; occiput linear, very narrow ; face projecting, as long as the head is broad,

ante- and post-clypeus very tumid and projecting, rounded and vesiculated; labium slightly longer than broad, split nearly to its base into two narrow triangular parts; labrum oval; antennæ with rudimentary first segment, second segment cylindrical, the most robust of all, third segment slenderer and longer, with its apex slightly tumid, terminal or apical segment longer than the third.

Prothorax elongate, narrower in front than behind, the anterior border raised, the hind with a large lobe, tumid and oval in shape.

Thorax moderately robust, compressed, forming about one quarter the total length of body, elongate, the dorsum flattened, the midthoracic carina often bifid so as to enclose a triangular space variable, in length, extending from one-fourth to the whole length of carina (when present, known as the 'midthoracic triangle,' and important for differentiating species).

Legs long and slender, extending to the apical end of segment 4 in males, to the end of segment 7 in females. Femora and tibiæ with long hair-like spines; tibiæ sometimes dilated, often densely pulverulent on the flexor surface; tarsal claws with a small spine at end, barely visible in some (*Rhinocypha*).

Wings hyaline or opaque, metallic or iridescent in the males, usually uncoloured in the females, of the same shape and size, but in some genera, the hindwings distinctly broadened, always longer than the abdomen, especially in the female long and narrow, markedly petiolated; reticulation close, cells tetragonal in shape. *Rii* and *I Rii* not fused with *Riv* + *v*: node nearer base of wing than apex; basal space entire, slightly longer than half the cubital space; discoidal cell straight, very narrow, traversed by one or several nervures, about one-third shorter than the basal space, its ends squared or the outer oblique; arc nearly straight or markedly bent, its sectors arising from near the middle from a single point or moderately separated; *Cuii* nearly straight or making a costal-wards curve after leaving the discoidal cell; *IA* without an inferior branch, straight or curved posteriorwards or undulated; no intercalated sectors between *Cuii* and *IA*; most sectors running straight, with but a little curve towards the termen of wing; many intercalated sectors; 4 to 20 antenodal nervures, the first and second or third being the primaries, all others not coinciding in the costal and subcostal series; pterostigma present in all wings, except in the forewings of *Micromerus* males, long and narrow.

Abdomen broad, depressed, especially in the male, short, segments 1 and 2 very short, the remainder nearly equal in length, squared.

Anal appendages all very similar, the superiors twice as long as segment 10, cylindrical, slightly broader at base, curved pincer-like towards one another at apices; inferiors very short, more robust, cylindrical, blunt at apices.

Genitalia variable in the genera.

Distribution. Africa, S. Asia, the Philippines and Australia.

Four genera found within Indian limits :—

1	Sectors of arc separated at origin; a pterostigma present in all four wings of both sexes ...	2
	Sectors of arc arising from a common point; forewings of male without a pterostigma	*Micromerus*, Ramb.
2	Wings stalked (petiolated) to far distal of the nervure *ac* (cubital nervure)	*Calocypha*, gen. nov.
	Wings petiolated to slightly proximal of the cubital nervure	3
3	Wings (at least the hind, except in *immaculata*) coloured in the male; *IA* not undulated at its origin	*Rhinocypha*, Ramb.
	Wings uncoloured in both sexes; *IA* undulated from its origin	*Libellago*, Selys.

Genus—Rhinocypha, Ramb.

Rhinocypha, Ramb. Ins. Nevrop., p. 232 (1842); (*Libellago*, pars) Selys, Mon. Lib. Eur. p. 200 (1840); Id. Syn. Calop., p. 59 (1853); Id.

Mon. Calop., p. 198, (1854) ; Walk. List. Neur. Ins. B. M., iv, p. 645 (1853) ; Burm. (*Calopteryx*, pars) Handb. Ent. ii, p. 826 (1839) ; Percheron (*Agrion*, pars), Gen. Ins. Neur. t. 2 (1835) ; Guerin (*Agrion*, pars) Mag. Zool. i. Ins. t., 15 1831).

Characters as for the subfamily ; wings of male, less rarely of female also, coloured vividly with metallic blues, violet, green or fiery coppery, at least in the hindwings, often with clear vitreous spots and stripes on hindwings which glow with opalescent rainbow tints ; antenodal nervures numerous, always more than six in number ; *IA* not undulated at its origin ; petiolation always ending proximal to *ac* ; shape of wings very variable, either all four very long and narrow, or the hindwing considerably dilated. Mesothoracic triangle nearly always present and brightly coloured in most species, of variable length, sometimes extending up to the alar sinus, but often much shorter than this. Legs long and slim, the hind pairs of tibiæ nearly always pruinosed white or yellow. Anal appendages as for subfamily.

Larva. Body short and robust, head squarish, the eyes representing the outer angles, antennæ seven jointed, the segments becoming progressively smaller from base to apex ; prothorax small, furnished with four small protuberances on the dorsum ; wing-cases lying parallel along the dorsum ; abdomen short and cylindrical ; legs of great length in the earlier instars, of moderate length in the adult, hind tibiæ extending to a short distance beyond anal end of abdomen, minutely spined, striped with pigment ; mask deeply bifid in the final instars, the edges of the fissure usually overlapping to enclose a small foramen, very long and flattened, extending as far as base of middle pair of legs in the adult, furnished with two lateral setæ and three hooks which may be bifid at the apex, moveable hook of great length ; caudal gills two in number, triquetral in shape, heavily spined, the 11th abdominal tergite present as an appendix dorsalis unmodified as a gill. Gizzard with sixteen folds each bearing four to five teeth. Found in running water, usually montane or submontane streams, clinging to weed or submerged twigs, etc.

The *Rhinocypha* as a whole, form a large genus of medium sized dragonflies, which possesses some of the most beautiful insects of the world. Not only do their wings display an inimitable play of scintillating colours, ranging through blues, greens, violet, pink to gorgeous fiery coppery red, but the bodies in most cases are also gaily decorated with red and blue or yellow of many shades. The picture afforded by a couple of males, circling round one another, their wings glittering with multitudinous rainbow hues, as they compete for the affections of an admiring female, is not readily forgotten. They are the living gems of tropic streams and delight the eye of even a casual observer.

When mating, the males perform a kind of nuptial dance before the female, during which they make a great display of the white pulverulent flexor surface of the hinder pairs of tibiæ. The legs are trailed and show up dazzlingly white in the strong sunshine.

Meanwhile the forewings flutter rapidly to support the insect, whilst that the hinder pair are held flat to display their wealth of colour. The female, perched on a prominent twig beside the stream, appears to be totally unconcerned by its mate's efforts to attract her. One very rarely sees a pair in cop, although vast numbers of both sexes may be present on the banks of the stream.

Less rarely a female may be seen ovipositing on a floating twig or broken reed.

In spite of the large number of species, it is extremely difficult to establish relationships, and their distribution presents many apparently insoluble problems. Roughly the whole genus may be split up into two large divisions.

Those with narrow wings, the hind scarcely broader than the fore, and in which *Riii* is widely separated and distad from the subnode.

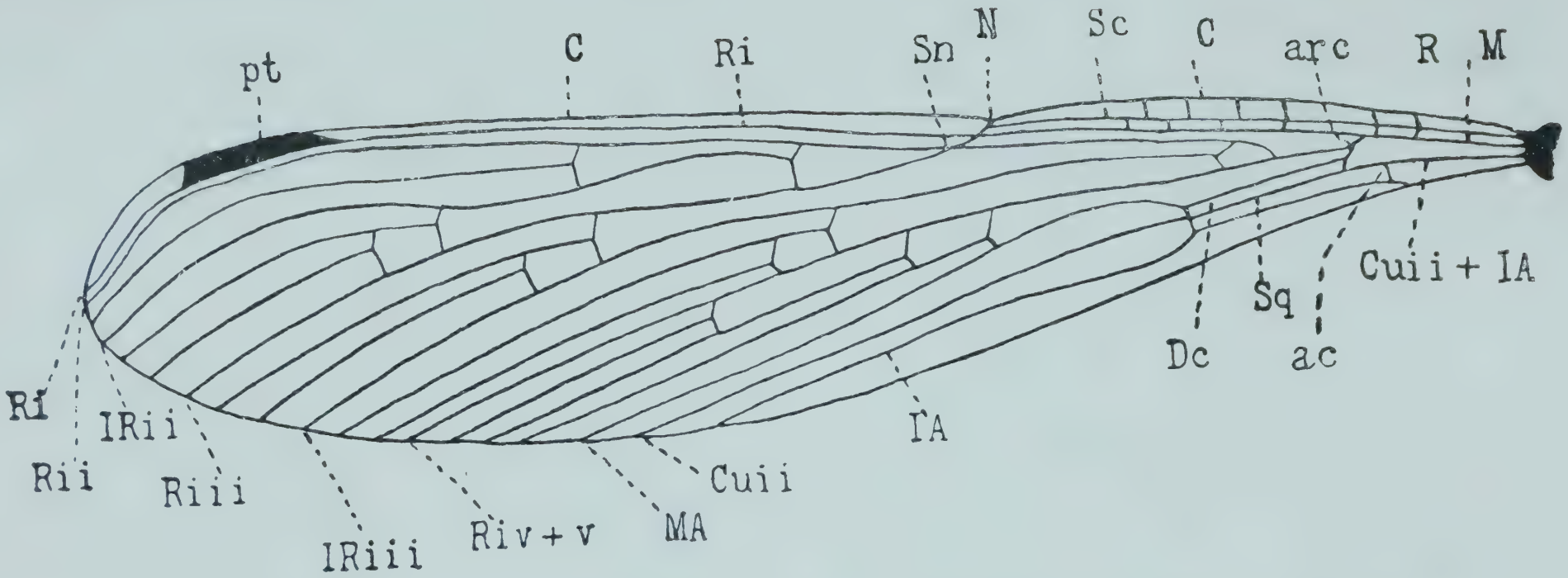
(E.g.,—*biforata, perforata, bisignata*, etc.).

Those with broader wings, the hind usually being much broader than the fore, and in which *Riii* comes off from the subnode.

(E.g.,—*cuneata, spuria, quadrimaculata, ignipennis*, etc.).

Ignipennis, trimaculata and *unimaculata* are clearly fairly closely related, not only from the colour of the wings, coppery in all, but also from the fact that all have an aborted mesothoracic triangle.

Iridea which shares this latter character, I am inclined to view also as closely related as the forewings are often coppery.



HINDWING OF *Rhinocypha immaculata*, SELYS, SHOWING THE MAIN AND INTERPOSED NERVURES ONLY
(For interpretation, see the Table of Notation given in the text.)

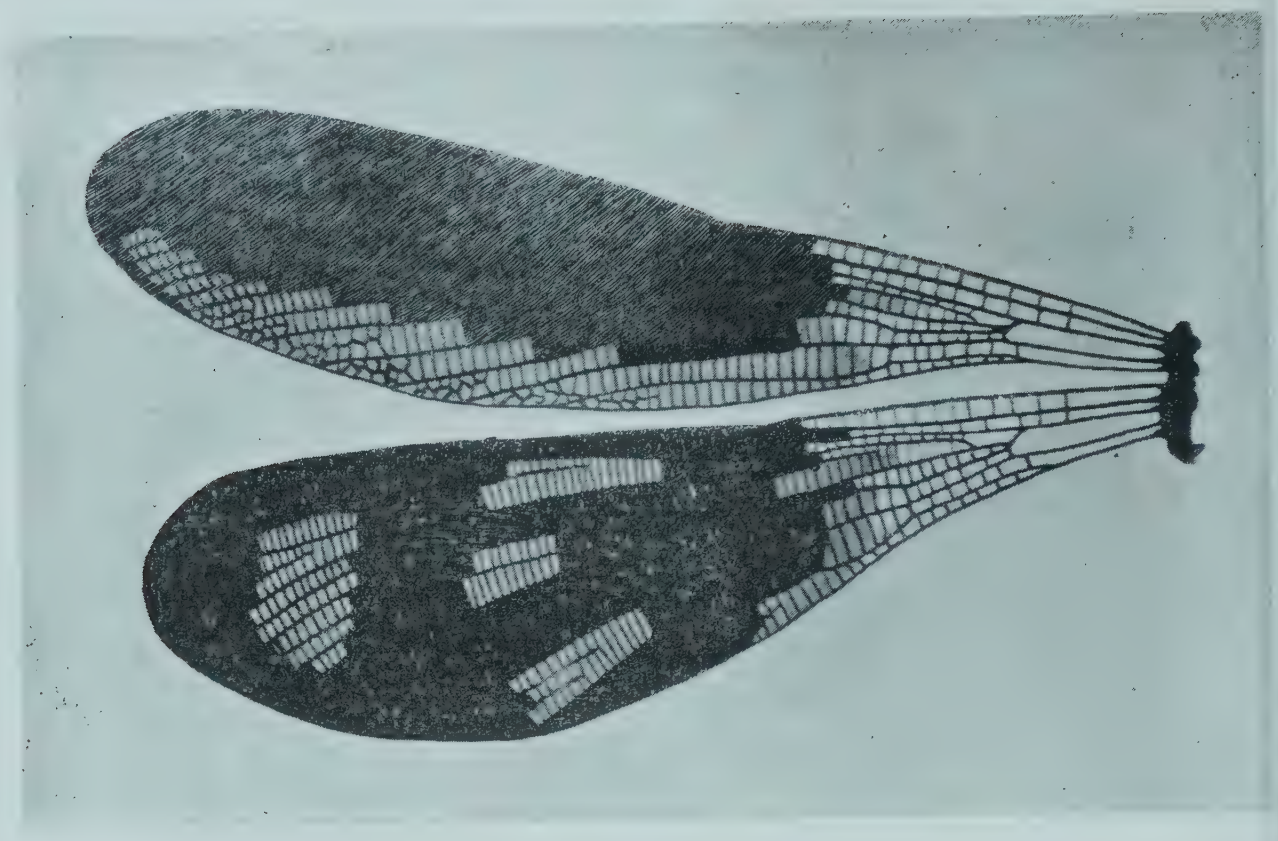


FIG. 1

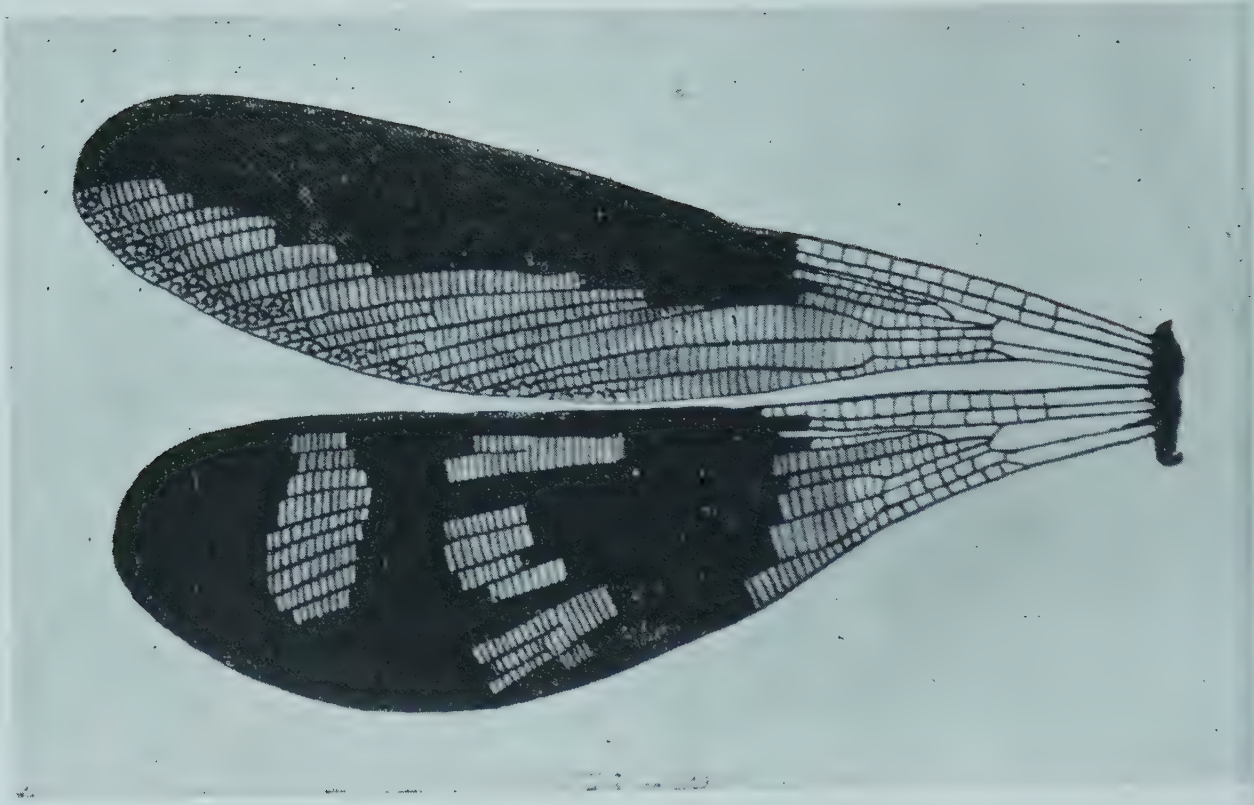


FIG. 2

FIG. 1. WINGS OF *Rhinocypha cuneata*, SELYS, MALE.

FIG. 2. WINGS OF *Rhinocypha quadrimaculata*, SELYS, MALE.

The black areas are steely blue or green, the shaded areas are vitrified and glow with blue, green, violet reflex according to the angle from which viewed.

A quite natural series, which may indicate a possible line of evolution is as follows :—

R. immaculata—hilaryæ—bifasciata—trifasciata—bifenestrata—spuria—and so on to the *fenestrella* group.

So far as the seventeen Indian species are concerned, it is possible to place them in four more or less natural groups, of which group *perforata* appears to be the most primitive.

Group I. *Fenestrella*

The third branch of radius (*Riii*) arising at the subnode ; wings opaque black with iridescent vitreous spots of blue, violet, or emerald green ; hindwings considerably broader than the fore ; mesothoracic triangle very large, extending to antealar sinus, coloured .—*cuneata—spuria—fenestrella—quadrimaculata.*

Group II. *Fasciata*

The third branch of radius arising at the subnode or very slightly distad to it ; wings hyaline or the hind marked with one or more opaque black bands running from costa to posterior border ; hindwings only slightly broader than fore ; mesothoracic triangle very large, extending to antealar sinus, coloured.—*immaculata—hilaryæ—bifasciata—trifasciata—bifenestrata.*

Group III. *Unimaculata*

The third branch of radius arising from the subnode or slightly distad of it ; wings fiery coppery metallic with iridescent vitreous spots of pink, violet or green (*iridea* has the hind wing and costal border of forewing opaque black with golden, or violaceous vitreous spots and stripe) ; hindwings usually broader than the fore ; *mesothoracic triangle obsolete.—unimaculata—ignipennis—trimaculata* and *iridea.*

Group IV. *Perforata*

Third branch of radius arising well distad of the subnode ; hindwings not broader than the fore, both pairs very narrow ; hindwings opaque only in the outer third or half, this area marked with one or two rows of iridescent vitreous spots ; mesothoracic triangle short, not extending more than half-way towards the antealar sinus.—*perforata—biforata—bisignata—whiteheadi.* (To this group also belongs *beatifica*, Fras., a race of *perforata*, and *beesoni*, Fras., a race of *biforata.*)

For the rest *adamantina*, Forst., is synonymous with *cuneata*, or at the most, merely a race of that species, whilst *hemihyalina*, Fras., is a race of *quadrimaculata.* Lastly *laidlawi* is transferred to a new genus.

Key to Indian species of *Rhinocypha.*

1.	Wings uncoloured in both sexes	*immaculata*, Selys. (Assam.)
	Wings coloured, at least partly, in the male. ...	2
2.	Dorsal mesothoracic triangle extending as far as root of wings	3
	Dorsal mesothoracic triangle either absent, uncoloured or extending not more than half way up to root of wings	8
3.	Hindwings of male with opaque bands	4
	Hindwings of male opaque with vitreous spots ...	6
4.	Hindwings of male with the apex narrowly black and an incomplete (more rarely complete) black band just proximal to pterostigma	*hilaryæ*, Fras. (Upper Burma.)
	Hindwing with the apex narrowly black and a black band lying about midway between pterostigma and node	*bifasciata*, Selys (Assam.)
	Similar to last but with a third, incomplete black band at the level of node	5

5. Apical, medial and nodal bands separated ... *trifasciata*, Selys. (N. W. Provinces.)

All three bands connected narrowly along costal and hinder borders of wing, thus enclosing two large spaces .. .. *bifenestrata*, Fras. (Assam.)

6. The large apical vitreous spot separated from the costal border by not more than one or two rows of cells ... ... *cuneata*, Selys. (Assam and Bengal.)

Apical vitreous spot separated from costal border by at least three or four rows of cells 7

7. Apical vitreous spot moderately small, lying exactly under pterostigma, medium-sized species ... *fenestrella*, Ramb. (Burma, Indo-China, Borneo.)

Apical vitreous spot large, lying almost entirely proximal to line of pterostigma, large species, hindwing 27–28 mm., mid row of vitreous spots more or less confluent ... ... *spuria*, Selys. (Bengal, Assam and Sikhim.)

Apical vitreous spot moderately large, lying partly proximal to line of pterostigma, small species, hindwing 20–24 mm., mid row of vitreous spots always well separated, the costal one extending much nearer to node than the middle spot ... *quadrimaculata*, Selys. (N. India.)

8. Mesothoracic triangle uncoloured, or entirely obsolete ; hindwing distinctly broader than forewing... 9

Mesothoracic triangle coloured, extending from one-third to half-way up dorsum ; hindwing nearly the same breadth as fore 12

9. Wings fiery burnished coppery metallic ; no opaque ares in forewings... 10

Wings opaque black, the hind with a sickle-shaped vitreous spot at distal end, which partially encircles the outer row of vitreous spots ; costal border of forewing narrowly black nearly as far as node ... *iridea*, Selys. (Upper Burma.)

10. Hindwing with a large subquadrate violety green vitreous spot at its centre ; very large species ...*unimaculata*,Selys. (Bengal and Assam.)

Hindwing with a medial row of vitreous spots and an inner linear spot 11

11. Small species, hindwing 23 mm. or less ; inner vitreous spot very elongate .. .. *trimaculata*, Selys.

Larger species, hindwing 26 mm. or more ; inner vitreous spot much shorter ... ... *ignipennis*, Selys. (Both from Assam.)

12. Only the apical third of hindwing opaque; a single row of vitreous spots 13

The apical half of hindwing opaque , two rows of vitreous spots ... ... *perforata*, Perch., and race *beatifica*. (Assam, Burma, S. Asia.)

13. Mesothoracic triangle very small, pink ; vitreous spots elongate ; only extreme apex of forewing tipped with black ... ... *biforata*, Selys. (Burma.)

Mesothoracic triangle larger, extending half-way along dorsum, pink ; vitreous spots shorter ; apex

of forewing tipped with black as far as inner end of pterostigma ... ... *biforata*, race, *beesoni* Fras. (Burma, Assam.)

Similar to the last, but nearly the apical third of forewing black ... ... *bisignata*, Selys. (Peninsular India, south of the Himalayas.)

Mesothoracic triangle small, blue; an isolated vitreous spot distal to the row of vitreous spots; opaque area of forewing equal to that of hind, intensely black, the vitreous spots peacock blue; wings markedly rounded at apices ... ... *whiteheadi*, Kirby. (Assam.)

1. **Rhinocypha cuneata,** Selys. Syn. Calop. p. 60 (1853); Id. Mon. Calop. p. 206 (1854); Walk. (*Libellago cuneata*), List. Neur. Ins. B.M., iv, p. 650, n. 14 (1853); Kirby, Cat. Odon., p. 113 (1890); Will. Proc. U.S. Nat. Mus., vol. xxviii, pp. 173, 174 (1904); Laid., Rec. Ind. Mus., vol. xiii, p. 36 and Pl. 11 (1917). Forst. (*adamantina*), Ann. Mus. Nat. Hung., p. 547 (1903).

Male. Abdomen 24 mm. Hindwing 27–28 mm.

Head. Ground colour velvety black, labium black, labrum black with a pale blue spot on either side, rest of head unmarked save for a tiny spot of rust red on the outer side of the ocelli, and another smaller, bluish, on each side of occiput. Eyes brown.

Prothorax black with a pale blue longitudinal streak on the middorsum of posterior lobe.

Thorax black, the mesothoracic triangle very large, extending as far as the antealar sinus, pointed at apex, palest blue in colour, a tiny humeral point just behind the upper end of the humeral suture, a linear streak along the anterior border of the second lateral suture, not extending up as far as wing roots, and dividing into two small spots below; lastly an upper short streak on the metepimeron, all reddish yellow.

Legs black, the two hinder pair of tibiæ pure white on flexor surfaces from dense pruinescence, the distal portion of the hind femora less so.

Wings opaque from apices to about 5–7 cells proximad of node, the bases hyaline, palely saffronated. The opaque area in forewings occupying roughly about the costal half of the wing, the hinder border of this area serrate. In the hindwings this area begins 4–5 cells proximad of node and runs obliquely back and out from this point in a very irregular and serrate manner, leaving a vitreous streak of pale violaceous anterior to the discoidal cell, which deeply indents the opaque area and runs inward to a little beyond the inner end of discoidal cell. The inner border of the opaque area, posterior to the discoidal cell is also violaceous vitreous. The opaque area presents a medial row of spots, all more or less confluent and presenting an infinite variety of patterns. The anterior or costal spot lies between *Ri* and *Riii* (first and second branches of radius) and is usually separated from the hinder two, it extends inward well beyond the others. The hinder spots usually confluent, extending to within one cell row of hinder border of wing. In addition to this medial row, a very large preapical spot extending from *Ri* nearly to hinder border of wing, oval in outline, its inner and outer borders serrate, its outer border in line with the inner end of pterostigma. The latter black with an elongate spot of pale blue at its centre. The iridescent spots and vitreous hinder area of forewings peacock blue or pale violaceous according to which angle viewed from. Abdomen black, unmarked. Superior anal appendages slender, sub-cylindrical, simple, curved in at apices; inferior half the length, moderately separated, slightly curved in at apices.

Female. Hindwing 28–30 mm. Abdomen 21 mm.

The female has hitherto been undescribed. The following description is made from specimens from Turzum, near Darjeeling:—

Head marked as for male but with the following additional spots, all bright gamboge:—a small pot on each side of the anterior ocellus and just anterior to its level; a large spot at the base of antennæ, a pyriform spot on each side of the frons, the cheeks narrowly, the bases of mandibles, and finally a small spot or stripe on each side of rhinarium.

Prothorax black marked with bright gamboge as follows :—a median streak on dorsum of posterior lobe as in male, a short streak on sides and a large oval spot laterally, just below posterior lobe.

Thorax black marked with bright gamboge as follows :—fine lines on the humeral and median lateral sutures, incomplete below, the same markings as seen in the male but considerably broader, especially the metepimeral marking which is broad and roughly triangular, finally a minute antehumeral streak on the lower part of thorax. The mesothoracic triangle mapped out in lines of yellow.

Legs black, not pruinosed Wings hyaline, evenly enfumed throughout, so that they appear brown when overlapping and folded over dorsum.

Abdomen black marked with gamboge as follows:—the dorsal carina finely as far as segment 7, a zigzag lateral stripe on segment 1, a lateral basal longitudinal stripe and an apical spot on segments 2 to 4, and the spot only on segments 5 to 7. A ventro-lateral stripe on segments 2 to 6. In some specimens many of these markings are more or less obsolete, the younger specimens being as a rule the better marked.

Anal appendages black, pointed, cylindrical as long as twice the length of segment 10. Vulvar scale very robust, extending to end of abdomen. Pterostigma brownish black clouded with enfumed white, oblique and rather squared distad, pointed within.

Distribution. Northern Bengal and Assam. I possess specimens from Gopaldhara, Assam and Turzum, Darjeeling District, also from Mangpu, in the latter district, collected by Messrs. H. Stevens, Oscar Lindgren, and Chas. M. Inglis. The type is said to have come from Thibet and may well have done so, it is a male in the Selysian collection.

R. adamantina Forst. (Ann. Mus. Nat. Hungarici, p. 547 (1903), is obviously merely a variety of this species.

The species is easily distinguished by the apical vitreous spot encroaching to within one or two cells of the costal margin of the wing.

2. **Rhinocypha spuria,** Selys., Bull. Acad. Belg. (2), xlvii, p. 388 (1879), Kirby, Cat. Odon., p. 113 (1890) ; Selys, Ann. Mus. civ. Genov. (2) x (xxx), p. 59 (1891) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 173, 174 and 177 (1904) ; Laid. Rec. Ind. Mus., vol. xiii, pp. 36 and 37 (1917).

Male. Hindwing 27–28 mm. Abdomen 24 mm.

Head black marked with citron yellow as follows :—a small oval spot on the outer side of each posterior ocellus and a tiny occipital spot on each side, these markings being similar to those of *cuneata*. Labium black, labrum unmarked.

Prothorax black marked with citron yellow as follows :—a linear streak on the middorsum of posterior lobe and a small spot at each of its outer angles, another larger spot below this and a large triangular spot on each side of middle lobe.

Thorax black marked with yellow :—an upper linear antehumeral spot, an upper humeral stripe broken above, hugging the hinder border of humeral suture, a broad irregular stripe on the sides on the hinder part of the mesepimeron and an elongate triangular streak on the hinder part of metepimeron, which is often broken in two ; lastly and occasionally a small spot on the upper part of mesepimeron and a tiny streak along the upper part of first lateral suture. All these markings, both prothoracic and thoracic subject to variability, the prothoracic and the smaller markings on the thorax often obsolete. Mesothoracic triangle very long and broad, lilaceous.

Legs black, the two hinder pairs of tibiæ snowy white from pruinescence on the flexor surface.

Wings opaque black with a steely blue or green reflex in the outer three-fourths, marked with vitreous spots and areas of lilaceous or purple. In some lights these spots have a mother-of-pearl reflex.

In the forewing, the opaque area covers the costal three-fourths of the wing, the vitreous area posterior to it having a beautiful violaceous reflex, the border of the opaque area markedly serrate Inwardly it begins four cells proximad of node and has a markedly jagged border. In the hindwings the same area begins about 2–3 cells proximad of the node and is indented by two vitreous areas, the anterior of which extends in for a distance of 4–5 cells, the hinder,

which is on the wing border, for a distance of 3–4 cells. The vitreous areas in this wing consist of a middle row of spots and an apical, the latter lying with its outer two-thirds under the pterostigma, and nearly quadrate in shape, being bounded by *IRii* and *IRiii*.

The middle row of spots are rather variable, consisting of four linear spots, the anterior or costal one made up of 2 rows of cells, the next of 2 or 3 at its outer end, the third of some isolated cells and the hinder of 2 or 3 rows at its outer end. The inner border of these four rows form a slightly convex outline, the second being a little more distad than the others. About 20 antenodal nervures in both wings ; four to five traversing nervures to the discoidal cell.

Pterostigma blackish brown, marked with a very large elongate lilaceous spot in the hindwings.

Abdomen black with dark metallic reflex, segment 1 with a small lateral yellow spot, 2 and 3 with a linear streak along the ventral border. Anal appendages similar to those of *cuneata*.

Female. Abdomen 22 mm. Hindwing 30 mm.

Head velvety black marked with bright ochreous spots, labium black, the lateral lobes white, labrum black, the whole of the central area yellow, deeply notched by a tongue-like prolongation of the black at base of labrum. In addition to the spots found in the male, the basses of mandibles broadly, the cheeks and basal segment of the antennæ, a small triangular spot on each side of rhinarium, a large triangular spot on each side of upper surface of frons, a small spot on each side of the anterior ocellus and lastly a small medial oval spot on occiput yellow.

Prothorax marked as for the male but rather more extensively.

Thorax with similar yellowish markings as in the male but these greenish yellow in hue and much more extensive. The upper and anterior lines bordering the humeral and first lateral sutures are generally complete and the antehumeral marking becomes a well-marked stripe extending in a curved manner inwards from the upper end of the humeral suture towards the antealar sinus and then straight down the whole length of the dorsum parallel to the mesothoracic triangle which is finely outlined in yellow.

Wings evenly enfumed and palely saffronated throughout, hyaline, unmarked. Pterostigma black, its central area ochreous. Fourteen to sixteen antenodal nervures in hind and forewings. Legs black, the two hind pairs of tibiæ pruinosed.

Abdomen black metallic with the following yellow markings : –segments 2 to 7 with the middorsal carina narrowly yellow, segment 1 with its apical border and a large curved or angulated lateral spot, segments 2 to 5 with a longitudiual basal stripe and an apical spot, as well as a ventro-lateral stripe. On segment 6, and sometimes 7, the apical spot only. Segments 2 to 6 with the apical border laterally yellowish.

Anal appendages and vulvar scale as in *cuneata*.

Distribution. Shillong, Assam, Kalaw, S. Shan States, Upper Burma, and Chin Hills. This species is one of the largest and most beautiful of the genus. It is specifically distinct from *quadrimaculata*, which is one of the smallest species of the genus. The difference in size is so striking, that when placed side by side, there is never any doubt as to which is which. Both Williamson and Laidlaw however express the opinion that, so far as descriptions go, the two are conspecific, so that it seems advisable to settle this point once and for all by pointing out the differences. In a large number of species I find :—

R. spuria

Distribution. Assam and Burma. Reticulation of wings rather open.

Vitreous stripes in hindwing invading the opaque black area for a distance of 3–5 cells.

Apical vitreous spot nearly square, limited posteriorly by the nervure *IRiii*.

Middle row of spots always 4 in number, the second spot from costal border equal in length to the hinder, inset but slightly, the inner border of pots shallowly concave.

R. quadrimaculata

Distribution. Kashmir to Burma. Reticulation very close.

Vitreous stripes extending distalwards into opaque area for a distance of 7–8 cells.

Apical vitreous spot transversely elongate, much narrower than long, extending one cell row posterior to *IRiii*.

Middle row of spots almost always 3 in number, the middlespot much shorter than the hinder and inset markedly to the others so that the inner border of spots is deeply concave.

Abdomen 24 mm. Hindwing 28 mm. Abdomen 19 mm. Hindwing 21 mm. The extent and shape of the apical spot is the best guide.

3. **Rhinocypha quadrimaculata,** Selys. Syn. Calop., p. 60 (1853) ; Id. Mon. Calop. p. 202 (1854) ; Walk. (*Libellago quadrimaculata*), List. Neur. Ins. B. M., iv, p. 651, n. 15 (1853) ; Kirby, Cat. Odon, pp. 112, 113 (1890) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 153, 174, 175 and 177 (1904) ; Laid., Rec. Ind. Mus., vol. xiii, pp. 36, 37 (1917) ; Fras. Mem. Pusa, Ent. Series, vol. vi, p. 54 (1921).

Male. Abdomen 19 mm. Hindwing 21 mm.

Head black with a small spot on the outerside of each posterior ocellus and a smaller spot on each side of the occiput. Labium and labrum black, unmarked.

Prothorax black unmarked. Thorax black marked with yellow as follows :— a fine humeral line interrupted below, and a moderately broad lateral stripe on the anterior border of the hinder lateral suture.

Occasionally a small elongate spot on the metepimeron, but this, as well as the humeral marking, usually absent (Teneral specimens have markings very similar to those of *spuria*, both on the prothorax and thorax, but although retained in adults of this species, they are invariably lost in adults of *quadrimaculata*, excepting the broader lateral stripe.) Mesothoracic triangle narrow, long, pink in colour.

Legs black, the distal halves of the two hind pair of femora and the tibiæ snowy white on the flexor surfaces from pruinescence.

Wings shaped as for *cuneata* and *spuria*, the hind considerably more broad than the fore, and dilated at the middle, opaque black with dark plum coloured steely reflex, and marked with vitreous areas and spots as follows :—an apical spot much broader than long, bounded by *Rii* costalwards, overlapping by one row of cells *IRiii* posteriorly, its inner and outer borders serrate. A medial row of spots usually 3 in number but occasionally 4, the anterior or costal spot made up of 2 rows of cells, and extending in towards the node much nearer than the other two spots of the series, the second or middle spot much shorter than the other two, and situated more distal than either. The third spot, when it exists, made up of 2 or 3 cells only. Lastly the posterior spot situated obliquely, so that its outer posterior corner may be in apposition with the hind border of wing, made up of 3 rows of cells. At the inner border of the opaque area, which is very irregular, are seen two deep indentations due to invasion of hyaline vitreous areas. These vary in extent but usually invade the opaque area for a distance of 6 to 8 cells. In the forewing, the opaque area covers the costal three-fourths of the wing, its hinder border being markedly serrate, and its inner border, which extends 4-5 cells proximad of the node, markedly dentate. The area posterior to the black area, vitreous and peacock blue or purple in colour according to the angle of view. The vitreous spots and areas in the hindwing purple or emerald green according to the angle from which viewed.

Antenodal nervures 16-18 in number : discoidal cell traversed 4-5 times.

Abdomen black with a vestigial lateral spot on the sides of the first segment and ventro-lateral stripes on third and fourth. Anal appendages as for *spuria*.

Female. Abdomen 20 mm. Hindwing 25 mm.

Head velvety black marked with ochreous spots as follows :—a reniform spot on the outer side of each posterior ocellus, a largish rounded spot on each side of the occiput and a medial oval or linear spot between and behind them on the hinder border of occiput. An oval spot in front of and on each side of the anterior ocellus, a large triangular spot on each side of the frons, a large spot on each side the rhinarium and a larger on the summit of that structure. The cheeks, bases of mandibles broadly, the second joint of the antennæ, and lastly two larger triangular spots on the labrum. Labium black, inner borders of lateral lobes yellowish white.

Prothorax black with a longitudinal medial stripe on the posterior lobe, and another rounded or triangular at each of its outer corners. A large oval mediolateral spot.

Thorax black marked with ochreous as follows :—the mesothoracic triangle finely mapped out in yellow, an antehumeral fine stripe, which begins at the upper end of the humeral suture, curves rapidly in and then down to anterior

border of thorax, running parallel to the mesothoracic triangle. A fine post-humeral line, complete, running close to and behind the humeral suture, another finer line running close to the first lateral suture and separated narrowly from an upper spot on the mesepimeron. A broad irregular stripe bordering the anterior aspect of the second lateral suture and finally an elongate spot on the metepimeron.

Legs black, hind two pairs of tibiæ and femora sparsely pruinosed.

Wings moderately, deeply and evenly enfumed with brown ; pterostigma blackish with a diffuse yellowish centre more conspicuous distad.

Antenodal nervures 14 to 15 in number.

Abdomen black marked with yellow as follows :—a very large spot on each side of segment 1, a broad elongate spot at the base and an apical spot on the sides of 2, which are repeated on the sides of 3 to 7, but the elongate longitudinal basal spot linear and gradually shortening from segment to segment, segments 8 and 9 with only a lateral spot, largest on the latter segment. The dorsal carina narrowly yellow from segment 2 to 7.

Segment 10 unmarked, anal appendages and vulvar scale similar to *cuneata*.

Distribution. Rare in Burma, its zoo-centre seems to be about Nepal. I have seen specimens from Almorah in Kumaon, Falodhi, and there is a specimen in the Vienna Museum from Kashmir. Mr Chas. Inglis has taken it in Sikhim and around Darjeeling, but sparingly, whilst Col. F. Wall, has sent me specimens from Maymyo, Upper Burma. It has also been collected around Dehra Dun.

It would appear therefore that *quadrimaculata* is gradually replaced eastwards by *spuria* and *fenestrella*, but that it is specifically distinct from both. The differences between the former are set forth above under the description of *spuria*.

Race *hemihyalina*. Fras. Pusa Mem., l. c., p 64 (1921).

Male. Abdomen 23 mm. Hindwing 23 mm.

Differs from typical *quadrimculata* by the opaque area of the forewing covering only the costal half and by the apical vitreous spot in hindwing extending back to 3 rows of cells posterior of *IRiii*, instead of only one. The mesothoracic triangle is lilaceous as in *spuria*. The opaque area of the hindwing is sharply bevelled off proximad so that the vitreous spots indenting it are merged in the adjacent vitreous area, and the border appears regularly indented or serrate. There is a fourth row of cells vestigial in nature in the medial row of spots.

Female. Abdomen 21 mm. Hindwing 28 mm. Not differing from the type.

A pair from Shillong, Assam collected by Mr. T. Bainbrigge Fletcher, now deposited in the B.M.

It is uncertain where the type of *quadrimaculata* is, but it is probably in the Brussels Museum, in the Selysian collection.

In a male from the Naga Hills, in my own collection, the apical spot is similar to that of *hemihyalina*, but the forewing is as broadly opaque as in typical *quadrimaculata*.

4. **Rhinocypha fenestrella,** Ramb, Ins. Nevrop., p. 236 (1842) ; Selys. Syn. Calop., p. 60 (1853) ; Id. Mon. Calop., p. 204 (1854) ; Bull. Acad. Belg. (2) xlvii, p. 387, (1879) ; Walk. (*Libellago fenestrella*), List. Neur. Ins. B.M., iv, p. 650, n. 15 (1853) ; Kirby, Cat. Odon., p. 113 (1890) ; Will. Proc. U.S. Nat. Hist. Mus., vol. xxviii, pp. 173–179 (1904) ; Laid. Rec. Ind. Mus., vol. xiii, p. 35–37 (1917).

Male. Abdomen 19 mm. Hindwing 21 mm

Head velvety black with an oval ochreous spot on the outer side of each posterior ocellus and another rounded spot on each side of the occiput. In the type, the former of these spots is vestigial and the latter obsolete, but in specimens from Borneo and Burma which I have examined, they are clearly visible.

Prothorax black with a longitudinal middorsal stripe on the posterior lobe, white. (Absent in the type.)

Thorax black with a bright citron yellow irregular stripe bordering the second lateral suture anteriorly, and an elongate spot on the metepimeron. The type has also a fine incomplete line on the humeral suture and another on the upper part of the first lateral suture. The mesothoracic triangle extending to the antealar sinus, palest pink or lilaceous. Four yellow spots beneath thorax.

Legs black, the two hinder pairs of tibiæ pulverulent white on the flexor surface.

Abdomen glossy black with steely reflex, the first segment with a small bright citron yellow spot on each side.

Wings hyaline at base, opaque black for the distal, three-fourths, the hyaline area tinted yellow, the opaque area steely green or blue, marked with vitreous spots which glow emerald green, lilaceous, mother-of-pearl or a beautiful rose pink according to the angle from which viewed. The opaque area in the forewing occupies variably the anterior three-fourths or half of wing, and in specimens from Sintang, Borneo, the vitreous area extends up at the apex as far as the pterostigma.

The hyaline area posterior to it in this wing and for some distance proximad at the base, is a beautiful vitreous peacock blue. The dark area has a very irregular border basad, and is markedly serrate behind.

In the hindwing, the opaque area begins about 5 cells proximad to the node and extends back in a very ragged manner as in *quadrimaculata*, leaving two deep indentations made by the bordering vitreous area exactly similar to *quadrimaculata*. In the Bornean examples the opaque area has a very oblique border, as seen in *hemihyalina*, so that these two indentations are barely visible from the other irregular serrations, and the bordering vitreous area is correspondingly broadened. At the apex of wing, *and situated exactly beneath the pterostigma* is a variably sized spot, but usually much smaller than the corresponding apical spot found in *cuneata*, *spuria* and *quadrimaculata*, being rarely more than 4 rows of cells in depth. Costalwards it is bounded by *IRii*, and posteriorly it extends about one row of cells beyond *Riii*, but is subject to slight variation from this.

The middle row of spots shows even greater variability, consisting of 3 or 4 spots, the two middle of which are often confluent. The spots do not vary markedly in length as a rule, as in *quadrimaculata*, and their inner and outer borders form a regular curve.

Pterostigma black, broadly lilaceous beneath, in the hindwing. Antenodal nervures 13 to 16 in number; discoidal cell traversed 3 to 4 times.

Anal apendages similar to those of *quadrimaculata*.

Female, Abdomen 17 mm. Hindwing 24 mm. (Rambur type).
,, 19 mm. ,, 28 mm. (From Upper Burma).

Head black, marked exactly the same as in *quadrimaculata*. Prothorax similarly marked to *quadrimaculata*, but the two lateral spots much larger. Thorax with an antehumeral fine line broadening below, and curved out above along the border of the antealar sinus as far as the upper end of the humeral suture; a fine line which starts above and behind the humeral suture, crosses its middle and ends shortly before the anterior border of thorax. Laterally the markings are similar to those of *quadrimaculata*. Below are found two long yellow spots shaped like the broad head of a stabbing spear. (These two spots serve to separate this species from the female of *quadrimaculata*.)

Legs black, the two hind femora distinctly pruinosed white.

Wings faintly and evenly enfumed tinted with yellow at the bases. Antenodal nervures 16-17 in number; discoidal spaces traversed four times; pterostigma black, dark yellow for the greater part of its centre.

Abdomen black marked with ochreous spots as follows:—a largish lateral spot on segment 1, a smaller apical spot on segments 2 to 7, and a ventro-lateral stripe on segments 2 to 4. The middorsal carina very finely from segments 2 to 7.

Anal appendages and vulvar scale similar to *cuneata*.

Distribution. The type, a male taken in 1825 is supposed to have come from Malacca, and is in the Paris Museum. A second male was taken at Pulo-Penang Isle—Prince de Galles. A third male, which was in the Dale collection, now in the B.M., is labelled 'India.' The co-type female described by Rambur, is in the Paris Museum and is labelled as coming from China. I have males from Sitang, Borneo and a pair from Gokteik, just above Maymyo, Upper Burma, collected by Col. Wall. It is apparently found scattered throughout Southern Asia in submontane areas. The Rambur female is teneral and incomplete, the description given above is the first complete one and was made from Col. Wall's specimen.

Fenestrella is easily determined by the position of the apical spot on the hindwing, situated exactly under the pterostigma, whilst the female may be recognized by the markings on the underside of the thorax.

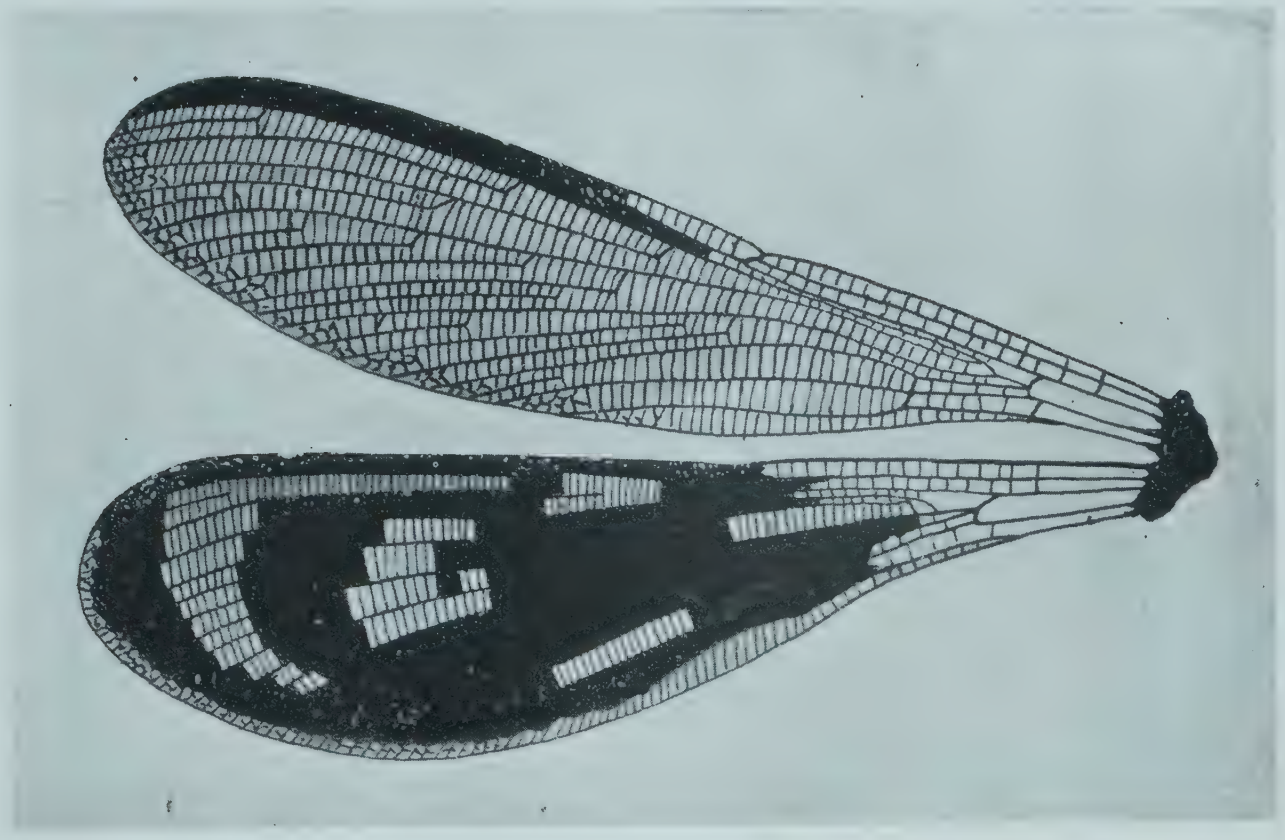


FIG. 1

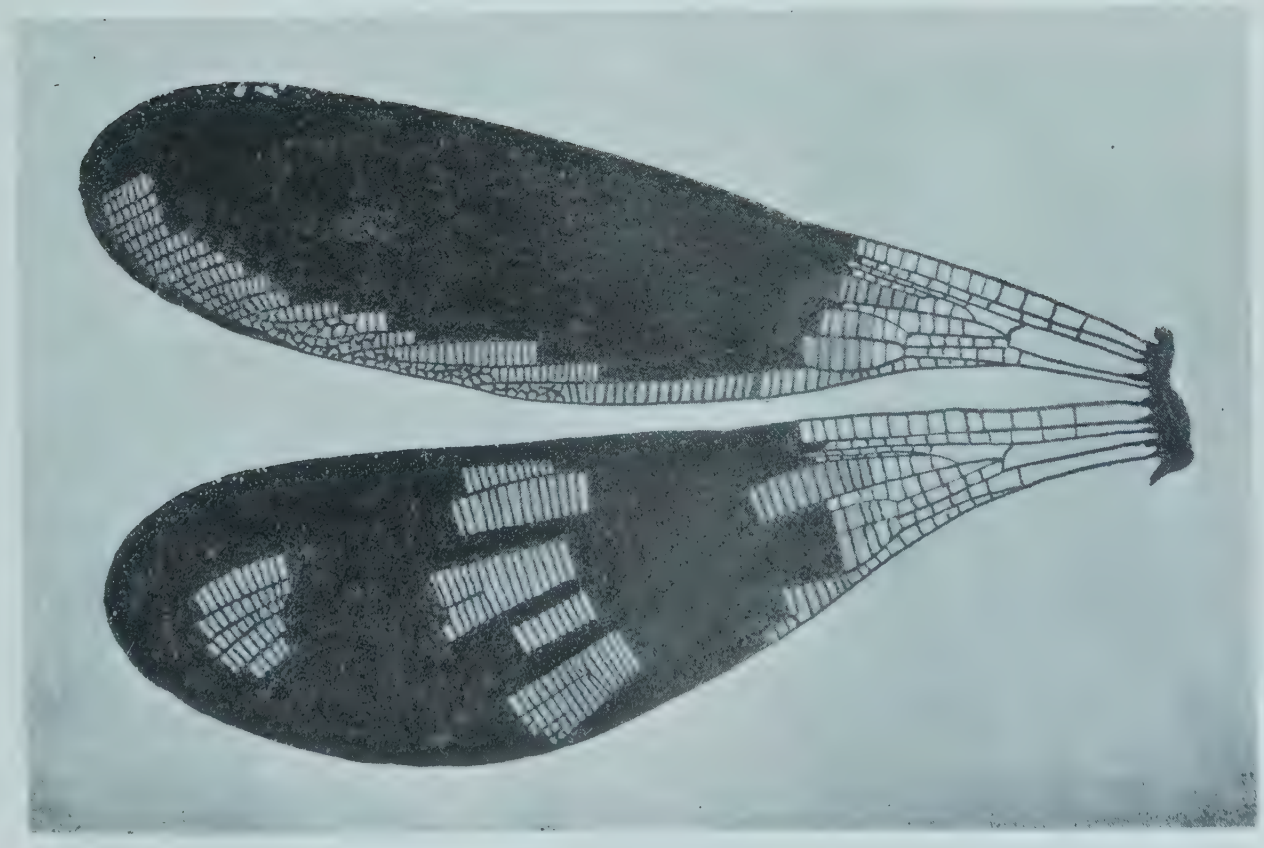


FIG. 2

FIG. 1. WINGS OF *Rhinocypha iridea* SELYS., MALE

FIG. 2. WINGS OF *Rhinocypha fenestrella*, RAMB., MALE

The black areas are steely blue or dark green, the shaded areas are vitrified and glow with peacock blue, gold, green or violet reflex according to the angle from which viewed.



FIG. 1. VIEW OF ROCKY BED OF A MONTANE STREAM IN SHILLONG, ASSAM, WHERE *Rhinocypha ignipennis* AND *spuria* ARE FOUND. OTHER ZYGOPTERA TAKEN HERE ARE *Matrona basilaris* AND *Echo margarita*.



FIG. 2. ANOTHER TYPICAL STREAM FOR *Rhinocypha ignipennis*. Pool below Seven Falls, Shillong, Assam. (*Photos taken by Mr. Bainbrigge Fletcher.*)

Rhinocypha iridea, Selys., Ann. Mus. civ Genov. (2) x (xxx), pp. 492–494, (1891); Will. Proc. U. S. Nat. Hist. Mus, vol. xxviii, pp. 173, 181 (1904); Laid. Rec. Ind. Mus., vol. xiii, p. 37 (1917).

Male. Abdomen 20–22 mm. Hindwing 25–26 mm.

Head velvety black marked with yellow as follows :—a small spot on the outer side of each posterior ocellus, a rounded spot on each side of the occiput and an oval spot on the posterior border at its centre. Labium black, the basal halves of the middle and lateral lobes yellowish white. Bases of mandibles bluish ; labrum with a broad transverse stripe pale blue, indented by a small prolongation of the basal black in the midline.

Prothorax black marked with azure blue as follows :—a medial, longitudinal stripe on the posterior lobe, a large lateral spot on each side of the middle lobe and a small spot at the outer angle of the posterior lobe. In teneral specimens, these markings yellowish, the hinder margin of the posterior lobe being narrowly yellow.

Thorax black marked with azure blue as follows :--a fine antehumeral stripe, curved outwardly above, expanding slightly below, an equally narrow humeral line lying along the hinder border of the humeral suture, a similar line adjacent to the first lateral suture, a broad oblique stripe on the hinder half of the mesepimeron not extending to the root of wings and broadening abruptly and markedly on the lower half of the mesepimeron. Finally the whole central part of the metepimeron.

Legs black, the two hinder pairs of tibiæ and distal two-thirds of the same femora densely pruinosed white.

Wings partly opaque, the hind distinctly broader than the fore. Forewings hyaline at base, vitreous towards the apex, the costa for a depth of two cell-rows opaque black as far as 10–12 cells distad to node, behind which the wings glow with an iridescence of many colours according to the angle from which viewed. The extreme apex is dull violaceous, the greater part of the wing golden green as far proximad as the node. The opaque area along the costa often extends nearer the node in the space between *Ri* and *Rii*, than between the costa and *Ri*. In the hindwing, the opaque area extends irregularly in as far as the middle of discoidal cell at that level, and for about 3 cells proximad of node along the costa. This area marked by vitreous spots and stripes as follows :—an elongate sickle-shaped stripe made up of a single row of cells, margined costalwards by *Rii* and beginning about 15 cells distad of the node, it extends distad to the level of middle of pterostigma at which point it turns down in a regular sickle-shaped curve. This end of the stripe made up of 12 rows of cells, broad at the costal end, tapering towards the hinder border of wing, which it nearly meets. The costal end of this curved stripe nearly continuous with an elongate spot which lies in the angle formed by *Rii* and *Riii* at the subnode, and which is about 18 cells long. Lying within the angle or curve formed by the curved band is another vitreous spot, which lies between *IRii* and *Riv* + *v*, is irregularly quadrate and very broken and jagged on its inner and outer borders. Immediately posterior to the first spot is a third, separated from it by 4 rows of cells and bordered behind by *Cuii*, equal in length to the subnodal spot. The whole posterior border of wings from the nervure *ac* to the outer end of *Ri* narrowly vitrified and hyaline. Finally an elongate spot which begins adjacent to the arc, bordered behind by *Riv* + *v*, and extending distad into the opaque area for a distance of about 18 cells. The sickle-shaped band and the border of wing glow golden green, the spots rose pink or purple or emerald green according to the angle from which viewed. Pterostigma black, yellow outwardly.

Abdomen black marked as follows with azure blue :—a triangular spot on each side of segment 1 and its apical border, an elongate spot and an apical point on each side of segments 2 and 3, the long spot abbreviated on 2, long and tapering to a point on 3, segments 4 to 8 with the elongate spot only.

Anal appendages similar to those of *Cuneata*.

(This description differs in several points to the original Selysian one, which was made from a sub-adult specimen. Thus the markings of the labrum, prothorax and thorax are given by Selys as yellow instead of azure blue. In this species, probably better than in any other known dragonfly, one sees the gradual development of colour, especially in the wing markings which develop gradually in the course of several days like the details of a developing

photograph. Mature specimens are comparatively rare in collections, most showing a thin greyish marking like an insufficiently exposed and under developed photograph. The fully adult insect is probably the most beautiful insect in the world, if one considers the combinations and harmony of colouring, together with the delicacy and artistic nature of the design in the hindwings.)

Female. Abdomen 20 mm. Hindwing 28 mm.

Head black marked with yellow spots as follows :—similar spots as found in the male, and in addition, a large rounded spot on summit of epistome, obsolete in adults, the bases of mandibles, a triangular spot on each side the epistome, two large subtriangular spots on the upper surface of frons, an oval spot on each side of the anterior ocillus, and lastly the cheeks narrowly. The middle and lateral lobe of labium yellowish white except the extreme tips.

Prothorax and thorax similar to the male but the mesothoracic triangle outlined in yellow instead of pink, and the markings more of a greenish yellow instead of blue.

Legs black, tibiæ and femora pruinosed white on flexor surfaces.

Wings entirely hyaline, tinted with greenish yellow ; pterostigma framed narrowly in black, clouded with blackish inwardly, yellow outwardly ; 14–15 antenodal nervures ; discoidal cell traversed 3–4 times in both sexes.

Abdomen black marked with azure blue as in the male, but the spots confluent to form a single stripe on segments 1 to 4, and segments 8 and 9 with an apical lateral spot. Segment 3 with a ventral stripe.

Anal appendages and vulvar scale similar to *cuneata*.

Distribution. Upper Burma only. Type in the Selysian collection, Brussels Museum, from Leito. It occurs from May to August at Maymyo, S. Shan States, Upper Burma, where Col. F. Wall found it comparatively common. Paratypes in the B.M., Pusa Museum, etc. The species is related to group *unimaculata* by the primitive condition of its mesothoracic triangle, which resembles that of the female.

(*To be continued*)

REVIEWS

1. A NATURALIST IN EAST AFRICA. By G. D. Hale Carpenter, D.M. (Oxon.), M.BE., Oxford University Press, 1925. Price 15*s*. 187 pages. Illustrations, Map and 7 Plates.

We have read Dr. G. D. Hale Carpenter's latest work with interest and can unhesitatingly record the opinion that it is a worthy successor to his *A Naturalist on Lake Victoria*.

Although primarily an entomologist the author finds plenty of time for the meticulous study of the fauna and flora in general with which he comes in contact, and many of his observations are of the greatest value.

The volume under review deals principally with insect colouration and mimicry described from various view points, but there is much else of absorbing interest to the field and scientific naturalist, and the subject matter, though in reality highly technical, is set forth in such pleasing fashion that it at once becomes acceptable to all.

Dr. Carpenter draws attention to a distinct link between Africa and America and quotes how he had the good fortune in Portuguese East Africa to procure a specimen of an exceedingly rare African Earth Snake belonging to a South American genus. He also instances certain snakes and day-flying moths which furnish interesting links between the two great Ethiopian and Neotropical areas.

The author has introduced a subject of the utmost importance, which has as yet received but scant attention from the field naturalist and scientist alike.

Much can be learnt about the past from the distribution of the flora and fauna of the present—much more than one is apt to realize. The picturesque photographs and carefully prepared plates are a welcome portion of the book a copy of which should be in the hands of every naturalist in Africa and we congratulate the writer on its general excellence.

It speaks volumes in favour of having a hobby, especially in tropical countries and still more so in time of war, and we hope that this work will be the means of inducing many others to take up natural science pursuits.

We have one quarrel with Dr. Carpenter and that is his use of an English nickname for a common African bird. 'Paddy-Bird' sounds extraordinarily out of place in a book of this class and is, we understand, used in reference to *Bubulcus ibis* (the Cattle Egret). Confusion is apt to arise from such nomenclature for the 'Paddy-Bird' or 'Pond-Heron' of Asia is also found in East Africa and Uganda.

We can visualize the author's horror at the use of the word 'Iguana' for *Varanus niloticus* (the Nile Monitor), so the ornithologist may well be forgiven his momentary shudder at the expression 'Paddy-Bird.'

C. R. S. P.

2. NOVITATES MACROLEPIDOPTEROLOGICÆ. By Otto Bang-Haas. Published in German by Dr. O. Standinger and A. Bang-Haas of Dresden Blasewitz, Volume I. (Price 15*s*., 9 × 6. xx. plus 238 pages.)

A catalogue of Palæarctic macrolepidoptera described since the publication in 1907 of Seitz 'Macrolepidoptera of the World', Palæarctic section, up to the year 1920. Volume II will deal with 1921–23 and Volume III with 1924–26; subsequent volumes will be issued as time goes on. The catalogue is arranged exactly in accordance with Seitz's work and for each new species, etc., described it gives the reference to the publication and the locality.

In the introduction the author admits that the Zoological Record furnishes year by year a list of all new names, but he does not like the arrangement, finds it incomplete, inaccurate and that localities are omitted. He acknowledges that all collectors and students owe a great debt to Dr. Seitz for his great work and since no revision or similar publication is likely to be issued for at least

a generation, he considers that the keeping it up to date by the means he has adopted is a necessity.

He comments on the multitude of names now possessed by the better known species under the designation of pro-species, super-species, vice-species, sub-species, geographical races, generations, varieties, mutations, forms, aberrations, modifications, hybrids, etc., and the consequent chaos as far as the collector is concerned. For instance *Parnassius apollo* had eight names in 1901 and now has 400.

He points out the difficulties attendant upon the making of a catalogue of this nature and how greatly the work would be facilitated, if every author would draw particular attention to the new names he had coined and describe the locality of the type specimen, so that it could be found easily on an ordinary map. In separates the publication wherefrom taken should be clearly specified and the original paying used.

The catalogues will be of the greatest assistance to systematic workers and their use may prevent to some extent the manufacture of new names, which for butterflies has assumed alarming proportions of late : in fact it is degenerating into stamp collecting and the truly scientific aspect is becoming obscured. Doubtless in years to come the League of Nations will take the matter up.

The catalogue is by no means free from errors ; a cursory glance has revealed the following amongst others :—

Page 76. *Ilerda viridis* is given as from Thibet : it should be Eastern Himalayas.

Page 91. *Lycæna orbitulus walli* is given from Thibet : it should be Chitral.

It is a pity that the author could not take in a little more of India into his Palæarctic zone : he gives North India as a locality in several cases, but he omits butterflies described from Kumaon, the Naga Hills, etc., where the Palæarctic elements are very pronounced. An improvement suggested for future volumes is to draw attention to specific names by setting them towards the margin, underlining or bolder printing.

W. H. E.

EDITORIAL.

Game Preservation.

We should like to bring to the notice of members the work of the Society for the Preservation of the Fauna of the Empire. The Society was formed in 1903 by the late Mr. E. N. Buxton and a number of fellow nature lovers with the main object of awakening public interest in the wonderful assemblage of wild fauna which still survives in many of the dominions and colonies of the Empire and of taking such steps as were possible to save them and also some of the rarer indigenous fauna of the British Isles.

The ideals of the Society are to impress upon every colony and dominion in the Empire the vital need of taking measures to ensure that the wonderful fauna of the lands which constitute the British Empire shall not be destroyed. It forms no part of the Society's programme to interfere with legitimate sport or to obstruct economic development, neither of these things being incompatible with the permanent existence of wild life. All that the Society desires to ensure is that beautiful and rare species of living creatures shall, so far as possible, be saved from extermination with which, owing to ruthless exploitation for personal gain and wholesale destruction by ignorant persons frequently equipped with all the latest resources of civilization, many of them are threatened to-day.

One of the main objects of the Society is the establishment of game sanctuaries in every dominion or colony where the fauna indigenous to the country can live in restricted freedom. To attain this goal the Society desires to make its membership as wide and as influential as possible and therefore appeals to all who may be in sympathy with the preservation of wild life whether at home or abroad to join its ranks. We feel certain that there are many of the readers of this journal who are in sympathy with the objects and purposes of this Society for the Preservation of the Fauna of the Empire and would be willing to assist it in carrying out its aims and purposes by joining its ranks. The minimum subscription is 10 *sh.* but it is hoped that those who feel that they are able to do so will subscribe a larger amount. Communications from those who intend to join, should be addressed to the Secretary, Society for the Preservation of the Fauna of the Empire, c/o Zoological Society of London, Regents Park, London, N. W. 8.

Agricultural Research.

The Agricultural Research Institute, Pusa, held an important place in the deliberations of the Royal Commission on Agriculture which recently toured India. We feel certain that much of the criticism levelled against the Department would be silenced if its labours were more fully known and received the publicity they merit. The recently published Scientific Reports of the Institute are an illuminating record of the work accomplished in various sections of the Imperial Institute of Agriculture. The improvement of the wheat and other cereal crops of India has occupied much of the attention of the Botanical Section of the Institute and practical evidence of the work is seen in the good yields of Pusa wheat in the Central and United Provinces and the extension of the distribution of these famous wheats to Bihar and Orissa. Trials with imported tobacco varieties have also been successful, and with suitable curing methods the possibility of producing cigarette tobacco in Bihar suitable for the overseas market is within reach. Other beneficial activities of the Institute include experimental work on the nature of soils and manures and the attacking of such practical problems as diseases of leguminous crops, sugarcane, and cotton and on the most effective methods of controlling serious insect pests. The efforts of the Department to improve the yield and quality of Indian milch cattle will meet with general approval. The policy now being adopted is to cross the half-bred Ayrshire-Sahiwal cows with pure Sahiwal bulls in order to adapt the imported Ayrshire milking strain to the needs of the country. The milk yield per lactation period of 300 days of 16 cows in

the half-bred Ayrshire-Sahiwal herd was over 6,000 lbs. Very important and valuable experiments on the nutrition of growing animals and the nutritive value of Indian coarse fodders were carried out by the Physiological Chemist at Bangalore. One important phase of the activities of the Institute is the provision of facilities for training Indian students in different branches of Agricultural Science at Pusa and at Bangalore. That an extension of this side of the work of the Imperial department is urgently required is seen in the evidence given by Mr. Bainbrigge Fletcher, Imperial Entomologist, before the Agricultural Commission. Mr. Fletcher emphasised that research work in Entomology should be carried out by a properly organised and centralised Entomological Institute. He showed that the total losses caused by insect pests in India could be estimated at the enormous total of 200 crores of rupees. The main need for the moment is more skilled workers and greater co-operation between workers. Mr. Fletcher referred to the inadequacy of the two years' course of training at Pusa and added that if training to the Imperial Service standard was to be given, a proper teaching staff must be provided. Entomology must be considered as a whole and entomology as applied to Agriculture could not be divorced from Entomology as applied to forestry, medical and veterinary work. Mr. Fletcher was of opinion that a proper course for training in Entomology should be so arranged as to give the student a general course in this subject for two or three years after which he could specialise in any special or particular phase of the subject. In Biological work it is the man who counts far more than any training and, unfortunately, the supply of really keen entomological workers is practically non-existent in India.

Wolf Children.

From time to time reports appear in the Press regarding the finding of human children in the lairs of wolves, living amicably side by side with their foster brothers and sisters—the wolf cubs—and being fed and tended by the parent wolves. The theme is of great antiquity : it recalls the celebrated 'Twin Brethren,' and has enjoyed credence through many ages.

Two stories of this nature have made their appearance before the public in the course of the last few months. One relates to two aboriginal girls, 2 and 8 years old respectively, who were found in a wolf's den at Midnapore, West Bengal. Bishop H. Pakenham Walsh, whose private letter on the subject was quoted by the newspapers, when written to for further particulars of the case, informs us that the Rev. Mr. Singh, (who according to the press report was present on the occasion of the digging out of the children from the lair,) only had the children given him by one of the rescue party a fortnight afterwards who also told him their story. The Bishop writes to say that Mr. Singh has photos of the children taken at various times after their recovery and he intends to write a book on the subject later, but to obviate the troubles of notoriety, he does not wish, in the interests of the children, to divulge anything further at this stage.

Evidently no clue is available to indicate the length of time the children had been with the wolves, but from Mr. Singh's statement that the girls had acquired animal habits, such as sitting down like quadrupeds, taking no food or drink without first smelling it, finding their food by smell, rolling their eyeballs and moving their jaws from side to side making a peculiar sound with tongue and teeth, would go to show that they had lived in these surroundings for some considerable time. This being the case, it is very probable that the younger girl was added to the lupine household at a later date, as we are told she was only about two when rescued. If it be assumed that both the children had been carried off simultaneously and had been with the wolves for a year or a year and a half, it would hardly account for the elder girl acquiring the canine habits to such perfection within so short a time, considering that she must have been $6\frac{1}{2}$ or 7 years old at the time of adoption by the wolves.

Since the appearance of this report, there has been a good deal of correspondence and some controversy on the subject through the press. One physician argued that it would be physically impossible for a human child to subsist on an exclusive raw meat diet which is presumably what the foster parents fed them on.

Whatever the merits of this argument, the fact that human children have repeatedly been found in the lairs of wolves must be faced, and it seems difficult to imagine that the foster parents could feed the children on anything but the food they gave to their own cubs—i.e. raw meat—often regurgitated. The question arises, can human children subsist on such a diet? If the answer is in the negative how can one explain the persistent recurrence of reports of this nature?

It must be owned, however, that stories like the above are rarely based on reliable first hand evidence, and most of them gather such proportions as they are 'passed down the line' as to cast reflections on even the few verified instances on record.

On page 142 of Volume IV of the Society's Journal will be found a very interesting account of a wolf-boy by Shams-ul-ulema Dr. Jivanji Jamshedji Modi and a reference to two other reliable instances of a like nature which were recorded in the Proceedings of the Asiatic Society of Bengal for 1875.

Still more extraordinary is the case reported by Mr. E. C. Stuart Baker in Volume XXVII, page 117 of this journal where he relates the incident of a child that had presumably spent three years of its life in a leopard's den. When seen by the author of the note the child exhibited many distinctly animal-like traits—squatting like an animal, putting his head in the air and sniffing about, bolting on all fours and when frightened backing 'like a small wild beast returning into its burrow'. According to the history of the case—as reported by the father of the child—the baby had been carried off by a female leopard whose cubs had been killed by villagers; attempts to recover the child were unavailing but three years later a female leopard was killed in the vicinity and two cubs, together with the child, were captured by the villagers in her lair. The child was at once identified by the parents and their claim admitted by the whole village.

A Biarritz paper recently published an interview with Mr. Rudyard Kipling where commenting on the recent discovery of a wolf child in India, he said, 'It is by no means impossible and there have been other instances of it already.' 'But they say,' continued Mr. Kipling, 'that the child crawls on the knees and hands. I think it would be much more likely that it would be on the knees and elbows, for that was the way of the other children like Mowgli who were adopted by wolves and knew all the mysteries of the jungle, so that their hands were free to seize their prey or defend themselves.'

It may not be generally known that Mowgli—famed far and wide through the Jungle Book—was a living individual and not merely a product of Mr. Kipling's imagination. According to the version of Mr. B. Ribbentrop, the lad, after he was reclaimed from the 'jungle log,' came under the notice of Mr. Ribbentrop's father during the latter's Inspector-Generalship of Forests in India, who was so struck with the boy's almost uncanny knowledge of jungle life and lore that he straightway appointed him a forest guard. We wrote to Mr. A. Rodger, the present Inspector-General, for corroboration and he very kindly caused a search to be made in the departmental records of the Central Provinces, but unfortunately without success.

Such stories always give rise to a great many difficulties and there is a line of argument, which compels one to a conclusively negative verdict! For instance, why is it that a monkey caught soon after birth and living the whole of his life among human beings without perhaps seeing another monkey during its life time, never learns to walk and behave like a human being, while, on the other hand, a human child reared, even for a comparatively short period, by wolves, in every known case has acquired the methods of progression and behaviour of its foster parents!

We should be very happy to hear of any first hand records our readers may be in possession of.

Poona Nature Study Club.

We have just received the first number of a magazine entitled 'Out-of-Doors' issued by the above club.

The club was started in July 1924 mainly through the initiative of Miss Payne, Inspectress of Girls' Schools, and we welcome its decision to publish its magazine which was considered essential 'to keep the club together and to make certain of its healthy development.'

The magazine is intended for recording the doings at rambles and meetings, for publishing observations and questions of members and for furnishing a means for members bringing to the notice of others, literature and methods in Nature Study. It is to be run on popular and not technical lines which is in our opinion one of its greatest attractions.

Popular Nature literature is sorely lacking in this country, a country which has been especially endowed by Nature with superabundant material for study, and we hope the good example of the Poona Nature Study Club will be followed by towns and cities all over the country. There never can be a glut in the ranks of such clubs and it can be said of them with more aptness than of many another institution that the more we have of them the merrier. More members are wanted by the Poona Club, and we would recommend all interested in the subject to communicate with the Honorary Secretary, Miss Fielding, High School for Girls, Huzur Paga, Poona City.

The Game Bird Books in Monthly Parts.

In our last editorial we referred to the need of popular books on Natural History and the publication in the near future of the 'Book of Indian Birds' which we propose issuing on the lines of the book on American Birds issued by the Geographical Society of America. The popularity of the book seems assured because it appeals to the many and will be cheap. There are other publications of the Society which appeal to the many but which are not popular because they are not cheap. We refer to the Game Birds of India series by Stuart Baker. Taking the first and second editions of the first volume—that on Indian Ducks—there are at present some 1181 copies reposing in Mess, Club and private libraries and there are 319 copies awaiting sale—of the second volume on Woodcock, Snipe, Bustards and Sandgrouse, 747 copies have been sold and 353 are awaiting sale. Is it to be wondered at that the Committee say 'We must sell more copies of the first two volumes before we publish the third'? But members of the Society who have the first two volumes are if not turbulent at least clamorous. If they want a thing they say so and amongst the clamorous ones, there are also those with ideas. The first two volumes are not selling, not because they are not wanted but because their capital value is too high. Many a man will buy a £1 share and increase his holding to £100 who would never have invested a penny had the share been £25.

So it is they say with our Game Bird books—bring out volume iii (Pheasants) in monthly parts, each with a plate, and when the parts are all issued issue a binding cover. The cost of each part will be within the purse of all. Some can buy outright and get benefit by doing so. But bring the Game Books within the reach of the many by reason of its price and you will obtain subscribers.

The idea has merits and has possibilities. In fixing the price not only would a concession be given to members but a concession would be given to those who owned Volumes 1 and 2 of the Game books.

We will imagine that the published price of the bound third Volume is £3-10-0 and that it is also brought out in 12 monthly parts at Rs. 4-0-0 per part. Very well, the member of the Society who has not got the previous books pays £3-0-0 for the bound third volume. He pays £2-10-0 if he has one of the two previous volumes and £2-0-0 if he has both. The monthly parts are only to be sold to members. If they are not owners, or do not become owners of either of the previous volumes they pay Rs. 4-0-0 per part. If they own one volume they pay Rs. 3-8-0 per part. If both Rs. 3-0-0 per part, or with binding say Rs. 45-0-0 in instalments. Does it appeal or is it too commercial? Does it sound too much of the Encyclopædia? It is in the interest of members themselves. We must translate our dead stock of books into the live stock of Government paper. If members wont have them, we, unfortunately know who will and that is the Termite. Termites have already got through one tin lined case and destroyed £100 worth of volumes. Well there is the suggestion and we shall be glad to have the opinion of members on it. The third volume of the Game Bird series which we propose to issue in parts will deal with Pheasants, Jungle fowl and Spur fowl and contain sixteen coloured plates and six black and white plates. The fourth volume will deal with the Partridges and Quails. The letterpress of the above volumes

first appeared in Volume XXIII No. 4 of this Journal and concluded in Volume XXX No. 2. A series of articles on the Waders and other semi-sporting birds is now in course of publication and will comprise when concluded the fifth volume of the series.

A Probable Change in the Constitution of the Society.

The Society as at present constituted, or rather unconstituted, suffers from several disabilities especially where the holding of property—whether or no in the form of Government securities—is concerned. The Committee have under consideration therefore the registration of the Society under the Act for the registration of Scientific Societies of 1860. The various clauses in the articles of Association have to be carefully considered and care taken that nothing is left out which ought to go in and nothing put in which, except for the lawyers' fees for getting repealed, would be the better left out.

One problem is the Rule and Governance of the Society. Every member who can record a vote has a right to vote for the Committee of Management and certainly all in India and Burma should be able to vote. The Committee of Management should however be composed of those who can meet together and discuss matters in person. This looks as though the Committee of Management must be composed of those who live within two hundred miles of Bombay and there will have to be—or it will be of advantage for there to be—an Advisory Committee of members from the Mofussil (Dare we include Calcutta and Madras within that word? We admit they are not mofussilites but they, like dwellers in Dusteypur, have not the good fortune to be Bombayites!) We shall thus still retain the useful services of many old friends. The proposals will in due time be sent to each member and amendments considered. There is one change which we do not anticipate any one will wish to make. The Society is not a Society of Bombay Naturalists (there are far too few of them). It is a Society of men and women studded over the face of India, Burma, Ceylon and many other countries, all working for the improvement of our knowledge of the fauna and flora of the Oriental region, but the Society started in Bombay and it has made the name of the Bombay Natural History Society well spoken of throughout the world. Let its maiden name remain unchanged even though it be wedded to the law.

The Dehra Dun Fishing Association.

In our last editorial we referred to the work of the Dehra Dun Fishing Association and published a request made by that Association to all interested in angling.

The Honorary Secretary is athirst for more information. The scales of the Salmon have been a mine of information to students of their life-history. Why should not the scales of the Mahseer also yield valuable information? He writes :—

'I recently read an article in one of the monthly Magazines (Pearson's) 'on "Solving the riddles of the Sea" and, *inter alia*, there was a section dealing 'with the markings on the scales of Salmon, by which its age, and almost 'its life history could be ascertained.

'It occurred to me that possibly the same could be done in the case of 'Mahseer. Accordingly I send you a scale of a Mahseer caught on 10th April, '1927 for favour of any information you can give me on the subject. The 'fish from which it was taken, weighed 2 lbs., dry, and its probable weight, 'wet, would be $2\frac{1}{4}$ lbs. Its length *over all* was 1 ft. 6 in. and to the fork of 'the tail 1 ft. $4\frac{1}{2}$ in. Its girth, dry, was $8\frac{1}{2}$ inches (probably about 9 inches 'wet). The weight does not conform to Thomas's rule that the Mahseer's 'weight is the *cube* of the length *in feet* from the snout to the fork. The rule 'does not take into consideration the condition of the fish and there should, 'I think, be a girth factor.

'On the scale sent, I can decipher only *one* ring, though under a magnifier two or more may be discovered.

'I propose keeping a record for a short while of various weights and sizes 'of fish and their scales to see if any information can be obtained regarding 'the relation of weight and age.

'Any hints in this connection would be thankfully received.'

ACKNOWLEDGMENTS.

Our acknowledgments are due to Major G. T. Fisher H. B. M.'s Consul at Seistan and to the British Vice Consul at Birjand for the very great assistance that they have afforded to V. S. LaPersonne, our collector, during his collecting expedition in Persia. Mr. LaPersonne has been in Persia since September where he has done good work; unfortunately in February this year he met with an accident which resulted in a broken left arm which was followed up by an attack of malaria. The British Vice Consul at Birjand to whom we cabled in reference to LaPersonne's illness replied that 'There would be no medical charges as Mr. LaPersonne was his guest.' Practical assistance of this nature is both helpful and encouraging and on behalf of the Committee we extend our thanks to this gentleman for his generous aid to our collector.

OBITUARY.

Edward Maxwell West.

We much regret recording the death of one of our members and an appreciated contributor to this journal, Capt. Edward Maxwell West of the 2/3 Queen Alexandra's Own Gurkha Rifles who was killed by the Kachins whilst on a Government mission in connection with the suppression of slavery in what is known as the Triangle in Upper Burma.

We echo the words of the Government of Burma Despatch 'The Governor in Council greatly regrets that one of the parties emancipating slaves has been attacked and that Capt. West, a very gallant officer, a Lance Naik, Agam Singh and one follower have been killed, three wounded and a civil interpreter reported missing.

It appears that Capt. West who was with an advance party was treacherously betrayed by two sons of the Chief of Nankhum, who were acting as guides, into an ambush of some 50 Kachins armed with muzzle loading guns, who opened fire killing Capt. West on the spot. Capt. West was buried at Kritaw, apparently some 14 miles south-east of Punbhum the military police outpost on the west of the river.

Capt. West's article on Takin Shooting which appeared in Volume XXXI No. 2 had made us look forward to many more articles by the same pen, and his untimely death is our very great misfortune.

Angus Peter Kinloch.

Mr. A. P. Kinloch joined the Natural History Society in the year 1912. He was an enthusiastic naturalist and a keen contributor to the pages of this journal.

Among the articles which have appeared under his name are the following :—

Rough notes on the Avifauna of the Nelliampathy Hills, vol. xxvii, p. 939.
The Avifauna of the Nelliampathy Hills, vol. xxviii, p. 279.
The Large Mammals of the Nelliampathy Hills, vol. xxix, p. 552.
On the Birds of Nelliampathy Hills, vol. xxix, p. 564.
The Nilgiri Tahr, vol. xxxi, No 2.

Mr. Kinloch was also of great service to the Society during the Mammal Survey and was always ready to render assistance to our collectors in the field.

In an editorial published in No. 4, Volume XXVII we made a reference to the death of his father, the late Mr. A. M. Kinloch, also a very keen naturalist, who met his death while hunting, having been killed by a wild boar which he had wounded and followed through the scrub, and we have now, with regret, to record the death of his son. Mr. A. P. Kinloch died at Seetagundy Estate, Nelliampathy Hills, Malabar, S. India, on the 10th February, 1927, from heart failure.

Angus Peter Airlie Hamilton Kinloch, age 31, was the son of the late Mr. A. M. Kinloch and grandson of Major-General A. A. A. Kinloch. Mr. A. P. Kinloch was a fellow of the Zoological Society, and a member of the B. O. U. He served in France in the Great War with distinction, being wounded twice, from the effects of which he suffered up to the time of his death.

He was a very keen naturalist, a good planter and a very hard worker, and his death is regretted by a very wide circle of friends.

MISCELLANEOUS NOTES

I.—OBSERVATIONS ON THE HABITS OF THE SLOW LORIS *LORIS LYDEKKERIANUS*

(*Reprinted from the Mysore University Journal, Vol. I, No. 1, January, 1927*)

(*With a plate*)

The South Indian Slender Loris, formerly described under the name *Loris gracilis*, is now recognized as comprehending two distinct species which have been named *L. lydekkerianus* (the Mysore Loris) and *L. malabaricus* (the Malabar Loris). Sometime ago, a large number of the local form were kept in captivity for long periods of time and it occurred to the present writer that most of their habits, which are practically unknown to the zoologists on account of the exclusively nocturnal mode of life adopted by them, might possess great interest in several particulars.

Two cages, $5\frac{3}{4}' \times 3' \times 2'$ and $4' \times 3' \times 3'$, with wire netting all round and above, were provided, and branches of suitable size stripped of leaves were planted in the centre. They were placed in a dark and less frequented portion of the laboratory, thus securing for the animals as far as practicable the conditions of their natural environment.

In nature, these prosimiæ are not colonial in the sense that the members of the genus *Macacus* are, and we find them leading almost a solitary life; occasionally a male is found in company of the female on the same branch. They invariably select shady, inaccessible recesses in the trees and spend the day in profound sleep with the head and hands tucked well under the abdomen,—an attitude not unlike that of the fœtus in the uterine chambers. I have never discovered them suspended from the trees in nature, though in confinement they are occasionally found hanging from wire-netting or branches in sloth-like fashion for a short time and as soon as they are freed from disturbance, they double up in corners. They are heavy sleepers and at the same time are extraordinarily wary. On the approach of man, the little creatures slowly elevate their heads, cautiously look round, and stare wildly, climbing up the terminal twigs whence they are dropped by long poles. Capturing them is by no means easy, for, if in the course of their involuntary descent, they touch another branch, they simply glide over to the next tree and entirely vanish from sight. The trees they most affect are the peepul, mango and tamarind whose barks their fur resembles so closely that the animals nearly escape detection from a distance. In the nights they leave their hiding places under dense foliage or holes and fissures in the stems and enter the lantana bushes of whose berries they are passionately fond, and when thus browsing, it is out of the question to capture them. They eat nearly every fruit with a hard rind, but in confinement they have steadfastly declined to touch potato, sweet potato, fresh and cooked; they would, however, greedily devour plantains, cooked rice and milk. Eggs broken and entire, minced meat and insects like grass-hoppers and beetles do not attract them. No doubt the dentition of these primitive creatures is usually described as insectivorous, chiefly because of the comb-like lower incisor teeth and the sharp projecting cusps on the pre-molars and the molars. The dental formula is $I\frac{2}{2}$, $C\frac{1}{1}$, P.M. $\frac{3}{3}$, M $\frac{3}{3} = 36$, certainly a more generous allowance than is allowed to the other South Indian monkeys. The upper incisors are vestigial and are rounded at the tips, besides being separated medially by a wide gap. The lower incisors point forward, which the lower canines resemble. When the jaws are pressed together, it is noticed that the incisors do not meet at all and under these circumstances it is really difficult to imagine how these teeth can be employed for crushing the hard horny investments of beetles on which they are reported to feed. Nor is the statement of Blanford that these prosimiæ find all the food on the trees they affect,—birds, birds' eggs, lizards and insects,—quite correct, for they have been noticed to change their habitation as often as they descend to the ground for the purpose



IN EXPECTATION OF THE EVENING MEAL.



ALL HUDDLED TOGETHER IN A CORNER OF THE CAGE
(*Miscellaneous Note No. 1.*)

of feeding, and it is my experience that none of the animals, which are said to form part of their food, excite the least interest. The sharp cutting cones on the grinding teeth might suggest a carnivorous diet and indeed the modification has gone so far that the first pre-molar of the lower series assumes the form and proportions of the upper canines against which it abuts. But the most extraordinary feature of the feeding habits of these animals is that they become so perverse in their tastes that they develop cannibalistic instincts in the presence of a dead companion of theirs. The soft snout, eyes, the external genitalia and other bare portions of the body are greedily devoured and still more puzzling is the fact that the female, totally devoid of maternal impulses, may be found making a meal off her own dead offspiring. In this respect these prosimiæ are totally opposed to the common female monkeys which are frequently observed to carry fondly in their hands their lifeless babies though in an advanced state of putrefaction. It seems to me that the real explanation of this debased character does not lie in the theory that these animals, normally carnivorous, develop cannibalism in captivity, but on the other hand, it is an expression of their mutually exclusive antipathies and jealousies which are avenged after death. In support of this view I might instance that after severe fights among the males which sometimes terminate fatally, the victor pursues his vengeance even after death by quietly making a meal of his erstwhile adversary. These habits are peculiar to animals leading a solitary life and subject to sudden fits of passion as in the feline tribe.

The slender loris has a curious drinking habit: exercising the utmost circumspection, he approaches the dish containing milk, and standing on three limbs, dips the fourth into the milk as suddenly as he withdraws it and licks the moistened hand leisurely. He repeats this a dozen times or more, soon after the milk is poured into the vessel in the evening, using the right or the left front limb indiscriminately but never the two together. When a powerful male is engaged with the dish, the others in the cage keep at a distance, moving about and setting up a plaintive cry not unlike that of a half-dreamy crow suffering from a nightmare. The younger and the female members may be seen drinking together in this odd fashion from off the same dish with few quarrels. I know of no mammal which uses the front limb as a spoon and no primate like the lemur which does not use it in eating,—the loris applying the mouth straight to the food in a quadrupedal fashion. Like all the rest of the mammals, the loris drinks profusely before proceeding to feed.

The Loris is a packed essence of pugnacity. When freshly captured and put into a cage, he objects to your presence by hissing and spitting in a wild-cat fashion, and if the hand is incautiously put in a wrong place, he will bite with great malice. When thoroughly roused, he will inflict a series of bites, chewing the flesh and holding firmly the opposing finger, until you squeeze the neck to release the grip. The wounds have to be touched with iodine immediately, else they heal with difficulty and sometimes suppuration may result. When trying to terrify you, he makes short leaps forwards rubbing his snout against the wire-netting and raising the whole body the while; but when thoroughly frightened, he will utter a piercing volume of yells like a wounded dog. These little creatures have a variety of 'voices' expressing their different emotions. After a comfortable feed on bananas, cooked rice and milk, they will be moving about for the pure love of exercise, uttering little cries of happiness very nearly expressed by the crows when they compare notes in the evenings or plan foraging expeditions early the next morning. When two males fight, they literally mew like cats and the sense of victory and defeat is expressed by a series of guttural sounds very similar to the chattering of monkeys. As I have stated already, fear or alarm is denoted by a low moan rising in a crescendo until it attains a fearful yell. Though the courtship of these animals is not an elaborate affair it is interesting owing to the fact that at the breeding time the males utter a series of short yelping cries as the little pups do when they rub their noses against your legs,—which noises are apparently musical to the ears of the female but perfectly ludicrous from the human standpoint. When happily perched in safe shelters, both males and females screech very like the little owls *Athene*, apparently going through a piece of unrehearsed musical composition, each member vying with the other in musical ability. It seems to me that these musical duets are in the nature of defying challenges, for they are abruptly brought to a close by two males locked in deadly grips.

Hunting for lice in which *Macacus* indulges his leisure so scarce in a life excellently adapted for larceny, is not a relaxation with the Loris. Like other solitary animals his coat is comparatively clean and in the evenings when he attends to his toilet, he is seen combing his fur with his pectinate lower incisors and moistening it with his tongue. He cleans his face, by no means pretty, with his hands and arms in a pecfectly cat-like fashion. When there is peace and understanding, I have noticed two adults of opposite sexes, softy combing each other's coats with their teeth,—a habit which we associate with the Dhobi's animal. Young lemurs are attended to by the mothers who keep them perfectly clean. I have found few lice and mites and ticks in their skin, but in captivity the bare portions of the limbs develop a kind of scab which is scratched persistently by the claw on the second digit of the leg till the surface bleeds. The limbs are sufficiently long to reach any part of the body for the purpose of scratching the irritating surface.

I have not succeeded in humanizing these little Ishmaelites into softer domestic ways; they retain their temper throughout confinement like the wild cats. But a friend of mine who has kept one or two of these lemurs as pets informs me that the animal can recognize its master and would come out to receive food at his hands without biting them. He asserts that beyond calling for food these little dreamy animals which look more metaphysical than poetic are incapable of expressing any other emotions towards man : and no psychology will avail in teaching them the simple lessons which are well within the scope of the ordinary simean cortex. The volume of education and the length of training are in direct proportion to the nature of life led by an animal, and in the present instance the wants of the loris being simple and easily satisfied, it has preferred to remain in comfortable dullness.

In South India these lemurs breed twice in the year. The sexual season falls in April-May and October-November. This is usually heralded by a wide-awake alertness on the part of both sexes in seeking out a mate. The period of pro-œstrum is marked by a sanguineous discharge through the genital orifice and the pendant clitoris and the margins below become swollen. On the conclusion of the pro-œstrum which lasts 7 to 10 days the male is received. But by far the most inexplicable part of the whole affair is that about this time, it is quite common to find two or three males stationed on the back or on the abdomen of a single female individual with perfect peace among them all. The female thus burdened may be seen moving about and the males are difficult to dislodge. When forcibly separated, however, instead of seeking another female, he runs after the old one who is already overburdened. In an animal whose life during the rest of the year is marked by mutual intolerance, a peaceful habit of this description is extraordinarily curious. The œstrum lasts for about a week and I must draw attention here to the fact that during coition the male holds the neck of the female by his teeth —a feature which is prevalent among the cats. Apart from the low calls of both sexes which resemble the gentle cawing of early crows occasionally rising to chatterings by which the sexes are attracted to each other, they develop a peculiar odour, weak but unpleasant, which must have a recognition value. After this brief lucid interval, they revert to sleepy anœstrum. The period of pregnancy lasts from five to six weeks, and usually two young ones are born at a time, rarely one. At the time of birth, the female parent is covered with a yellow sweet smelling thin paste in the region of the mammary glands which are four and are now uncovered. The young ones crawl up clutching the hair of the mother and without any assistance on the part of the parent seek out and apply the mouth to the teat. In the earlier periods of growth the mouth is scarcely removed from the teats. It takes nearly a week or ten days for the baby to leave its station and try clutching the twigs. In captivity if the young ones are handled, the mother runs away instead of rescuing them or even resenting the action. It seems to me that the Slow Loris is a vast riddle.

C. R. NARAYAN RAO, M.A.,
Department of Zoology, Central College, Bangalore.

[Mr. Narayan Rao's remarks in reference to the female Slender Loris being devoid of maternal impulses corroborate Mr. Shortridge's statement that an angry female when irritated ' would even vent its rage on its own young which would chatter and bite back but never let go its hold ' (Mammal Survey Report,

No. 9, *Journ., B.N.H.S.*, vol. xxii, p. 286). In his note on the Malabar Slender Loris (*Journ., B.N.H.S.*, vol. xxvi, p. 836) Mr. Kinnear mentions the incident of a newly born loris dropping off its mother one morning and 'after a few attempts to pick it up from a branch too high above, the mother gave up and retired with the remaining one to another corner of the cage.' As regards the food of the Slender Loris the same note records that a pair of Jerboas which occupied the same cage as a female loris in the Society's rooms, were killed and partly eaten by the latter. A Slender Loris kept alive in the Society's rooms fed readily on grasshoppers. Mr. Shortridge in his note mentions the same fact. He states that they are 'specially fond of grasshoppers, which they would hold in one hand and take bites from.' The pugnacity of these animals is confirmed by most writers who have had experience of them. Shortridge writes, 'They are extremely pugnacious and when several were kept together would fight and keep up a continual squealing throughout the day and night, while every day one or more would get killed probably more from exhaustion than anything else. Their method of fighting was very peculiar, it consisted of gripping each other by the fur of the head in order to keep the other's head away and then biting each other on the feet and hands drawing blood freely.'

Commenting on the noises made by the animal, Shortridge likens the sound made when fighting to the screech of the Spotted Owlet (*Athene brama*), he also traces a similarity in the appearance of the loris to the bird when in a tree especially among foliage, and remarks that the likeness is further manifested in their owl-like habit of swaying their heads from side to side. The only other sound ascribed to them by Shortridge is a faint chattery noise rather like that uttered by a monkey when irritated. Mr. Narayan Rao's description of the alarm note of the animal culminating in a 'fearful yell' appears a remarkable feat for so small an animal! EDS.]

II.—MAN-EATING TIGERS

I wonder if it is common for a tiger to make a solitary human kill and then renounce such food?

About two years ago a gang of coolies were regulating shade in a young tea clearing on these hills. At mid-day they went to their lines for food leaving one of their number behind. He presumably fell asleep. On their return all that was left of him was his cloth and bill-hook. They noticed tiger tracks and ran off to call the writer (the spot was about 10 yds. from a public road in full view and very much within hearing of a set of cooly lines). The writer some hours later pluckily (or foolishly) followed the tracks out of the tea and into some dense lantana where the top of the man's skull was found and further on the headless and limbless trunk. A friend then arrived upon the scene and as unfortunately neither of us was able to sit up, we, with the consent of the man's relatives, poisoned the corpse with strychnine (we could not allow such a danger to our labour to live) and carried it through a dark, gloomy ravine. It was nearly dark by now and following the tiger's tracks with our gruesome burden in that eerie light was jumpy work and when a monitor rushed off through the dry leaves my heart stood still! At last we left the corpse at a spot near water. Next morning an old, almost toothless panther was found dead and the tiger had also eaten and rolled about, but had vomitted and cleared off. He was seen the next day crossing a grass hill. Since then there have been no human kills (possibly his painfnl experience of the poison deterred him from further experiments?) and this was the first one on record in the last 50 years or so.

NELLIAMPATHY HILLS,
Janury 10, 1927.

A. P. KINLOCH, F.Z.S.

III.—A PANTHER TREEING ITS KILL

(*With a photo*)

I enclose a photo of a panther's kill up a mango-tree, which might be interesting enough to publish in the Journal. The circumstances are as follows:—On December 26 I sat up over a panther's kill (a small cow), the panther came on at dusk and I got him dead with one shot (with a 280 Ross), he proved

to be a good-sized male, 7 feet 1 inch. Next morning at 7 a.m. I came along the scene of the kill and disturbed another panther off the remains, I could not get a shot as only its head was visible for a second. That evening, 27th, a friend of mine sat over the remains in the same machan, a hollowed out cactus bush, but the panther did not appear up to 8 p.m., so he came back. I went there the next morning at about 6.30 a.m. and on approaching the place, saw the panther jump from a mango-tree overlooking the kill and on getting up to the tree I found the remains of the cow placed as shown in the photograph at a height of 8 feet from the ground ; as can be seen there was very little left of the cow, only its head, legs, skin and bare ribs and piece of the backbone, all devoid of meat except the head which was intact. There were claw marks up the trunk showing how the panther had sort of swarmed up it dragging the remains. which I estimated weighed about 20 lbs.



My friend sat up over the remains, which we pulled off the tree, but nothing came except two large mungoose and he returned to camp at 9 p.m. ; next morning there was nothing to be seen of the remains, they had all been carried off or eaten, a panther's tracks were plentiful all round, also those of two cubs, so the beast was evidently a she-panther ; it was curious the cubs had not been with her before.

AJMER,
January 14, 1927.

W. M. LOGAN-HOME,
Major,
4th Bombay Grenadiers.

[Several notes have appeared in the Journal on the well-known habit of

panthers 'treeing' their kill. A photograph appears with a note on the subject by Mr. Coleridge Beadon on p. 744, vol. xix. EDS.]

IV.—WILD DOGS ATTACKING CATTLE

Recently a pack of Wild Dogs attacked a herd of my cattle here, devoured four calves and half-killed a cow. This is the first instance I have ever known of Wild Dogs attacking grazing cattle : though they have killed cattle that have been tied up as baits for tiger last year and this year.

These cases prove the increasing boldness of these dogs. Their increase in numbers, and diminishing numbers of deer, which they are exterminating, are causing them to harm cattle. On top of this the rewards previously given for their destruction have been withdrawn.

ATTIKAN P. O.,
MYSORE,
March 2, 1927.

RANDOLPH C. MORRIS.

[The reason for the withdrawal by the Madras Government of the rewards paid for the destruction of wild dogs was, we understand, a matter of retrenchment. Whether the saving effected by this means is sufficient to justify Government's action is a matter for speculation.

The Nilgiri Game Association have however found it possible to recommence the payment of rewards for the destruction of these vermin and the keeping down of Wild Dogs within due limits is more or less assured in the area under its control. Europeans resident in other areas subjected to the depredations of these pests will do well to destroy wild dogs irrespective of whether rewards are paid for them or not. The most effective way of dealing with the wild dog is by destroying the litters. The jungle man mostly knows where the whelps are dropped but he likes the Wild Dog, who often provides him with food, and is reluctant to aid in its destruction, still by paying liberally for whelps it is possible to get a good number brought in provided that the jungle man has not to travel too far to claim his reward and provided he is certain of receiving payment in full. Europeans residing in a district infested by Wild Dogs might band themselves together to secure prompt and easy payment for the destruction of litters. EDS.]

V.—JACKALS IN RESIDENTIAL COMPOUNDS

Reference a note by Mr. C. M. Inglis on jackals in a compound. Two jackals inhabit the extensive compound of the bungalow I reside in, presumably a male and female, and are very tame, appearing during most hours of the day. I frequently see the male chasing the female in the manner described by Mr. Inglis.

The hair on the male's neck is erect but his tail stands straight up and does not curve over his back. I imagine it is the preliminary stage of courting.

One afternoon I saw a pie-bitch slink out of a patch of high grass followed by the male jackal, who, with bristling hair and bared teeth, made short runs at the dog hissing like a tom-cat. The jack never actually closed with the dog. In a short time the female jack came out of the grass and trotted off in another direction whereon the male left the pie-dog and followed her.

DALTONGANJ,
PALAMAN DISTRICT,
December 15, 1926.

RODNEY FOSTER,
Major.
No. 1 Party, Survey of India.

VI.—THE MATERNAL INSTINCT IN THE DWARF PIPISTRELLE, (*P. MIMUS MIMUS*)

Owing to the almost purely nocturnal habits and swift movements of bats, as an order, it is not often that the opportunity is presented to us and we are enabled to gain an insight into the more intimate life of any one of the species that we so often see flying around us in the dusk.

Such opportunities occasionally do occur, however, and as so little beyond the general outline is known of the habits of most of our Indian species, it seems worth while putting on record any new facts concerning their lesser known ways that may come to light; especially so when as in the present case, we meet with a phenomenon that we do not altogether understand,—I refer to the sense or 'instinct' that enabled the mother bat to discover her lost offspring.

One morning last month on returning to the bungalow after a morning spent on a Rubber estate, I was presented with a wee small bat—a very young Dwarf Pipistrelle, scarcely a quarter grown—alive but hardly yet able to crawl about freely. It had apparently fallen down from the roof outside the dining room windows from a colony of these bats, known to live in a hole beneath the eaves.

The young bat was placed in an ash tray on my writing table in the dining room to remain there until its fate should be decided upon and it could be disposed of.

In the evening, just as dusk fell and the lamps were lighted, forgetful of its presence, I sat writing at the table on which it lay, when I became aware of a bat fluttering round me and flitting about the rooms, an unusual, occurrence calling for remark. After watching this bat for a few moments it became evident that my desk was the centre of attention and it then dawned upon me that, possibly there was the mother come for her lost offspring—the young bat reposing in the ash tray.

Keeping quite still therefore I watched intently the movements of both, the young one being within 18 inches of where I sat, and a few minutes later, after a number of abortive attempts and much fluttering of wings, the mother bat—for so she must have been—dropped and alighted upon the ash tray beside her young one, which with her aid immediately scrambled round until it could cling to her and be suckled from her nipples.

After a few moments of this, and after having moved it about until it was comfortably settled and attached to her, with a laboured flap or two the mother rose into the air again, carrying her young one with her, and disappeared out of the open window after circling round and round the room for several minutes.

* * * * *

Curiously enough almost the same performance was repeated again a few weeks later with the difference that on this occasion there were several people present to witness it and the young one—a lively half-grown one this time—was put in a more easily accessible place. In this case, having returned late from Colombo, I noticed and remarked upon two bats flying round the room during dinner—to be told that a young bat had been found upon the floor and had been placed in a closed box to await my return.

Upon releasing the young bat which was well able to crawl but quite unable to fly, and placing it upon a book on a near-by table, one of the adult bats flew round and down towards it and after many attempts and much flying to and from eventually settled beside it and commenced to suckle it.

Seeing her engrossed thus, I switched on an electric torch and approached within a few feet, standing and watching while she suckled her young one which she continued to do for several minutes without taking the least notice of my close approach or of the strong light of the electric torch.

Eventually she too adjusted her young one and with it hanging to her breast launched herself off (with some difficulty, being much impeded by its weight) and disappeared out of the room into the night.

The foregoing would seem to indicate a degree of maternal affection unsuspected in this species of bat, the smallest in the Indian Empire. Not only has the mother bat sought out and discovered her straying offspring but she has ignored the close proximity of human beings and has continued to minister to its needs in spite of abnormal conditions.

I am however at a loss to understand how in both cases, the mother was able to discover the whereabouts of her young one. In the first case the young one was close beside me on my desk and I can vouch for it that it neither moved nor uttered any sound audible to human ears, until the mother alighted beside it and yet she appeared to know perfectly well where it was to be found although it had been on the desk since the morning and had been carried 10 or 15 feet from where it had been first discovered on the floor.

In the second case the whereabouts of the young bat were discovered by its mother while it was actually still shut up in a box, for when first seen she was circling over the table on which the box stood, and the table was some distance from where the young bat was picked up in the first instance.

In both these cases the mother would appear to have been guided to its offspring by some sense of which we are ignorant or else, alternatively, by a wonderfully developed sense of smell or hearing.

MATUGAMA CEYLON, *January 20, 1927.* W. W. A. PHILLIPS, F.Z.S., M.B.O.U.

[The sense of hearing is very acute in bats and they are believed to be able to 'take in' sounds not ordinarily perceptible to the human ear. In no mammals are the ears so developed or so variable in form as in bats; in most of the smaller insectivorous species they are longer than the head and in one species the length equals that of the whole head and body. In several families of insectivorous bats a process called the tragus, or inner ear, rises inside the anterior margin of the ear. The tragus in some species is so large that if extends nearly to the outer margin of the conch. The function of the tragus appears to be to intensify and prolong the waves of sound by producing undulations in them. EDS.]

VII.—NOTE ON THE DESERT GERBILLE (*CHELIONES HURRIANÆ*)

These pretty little animals which are desert dwellers, as their name implies, are commonly to be met with in places where the sand has consolidated, living in colonies in burrows. These burrows are usually deep and made in bunds and dunes, both far from and near cultivation. A common haunt of these gerbilles is the flats where *Salvadora persica*, a small tree, grows.

It is a common sight to see them out at all parts of the day, sitting at the mouth of the holes and performing their toilet duties both in winter and in the height of the hot weather.

They possess a luxuriant growth of whiskers and these glisten and reflect the sunlight as they are moved about. This part of the animal arrests one's attention first.

If approached quietly they will permit one to come within a few feet, but on the slightest alarm will all disappear into their holes. Now if one sits quietly in a bush, soon one head and then another will peep out and then pop in again. As soon as they realize the danger has passed they will all come out and the whole colony will again be quite active on the surface.

A peculiar drumming noise is made with the hind feet a very quick *tu tu tu tu*, etc., when the animal is alarmed or curious. This point I observed with specimens in captivity. Six specimens of this interesting animal were forwarded alive to the Society by Mr. Laird-MacGregor from Gujerat. Three of them died but the survivors are doing very well. Their chief diet was Jowari and paddy until one day I gave them grasshoppers by way of a change and found that they were eaten with great relish. They drink water freely. They are very fond of gnawing and have in consequence almost eaten through their cage. The arched tiles under which they live are not spared.

The burrowing habit is inherent in these animals and even in the cage they are shifting the sand about from one place to another. Often I fill up the tile and watch them burrow. The sand is removed to the rear with the forelegs and is from there kicked away in turn by the hind legs in a galloping motion, when the mouth of the tile is open the animal goes in and continues kicking the sand out until it makes its appearance on the other side. It now turns round and goes out by the same hole through which it went in and removes the sand again from the mouth of the tile. I have not observed them to make any noise beyond a faint squeeking sound when held up by their tail.

When handled they very rarely if ever bite.

BOMBAY, *April 12, 1927.* C. McCANN.

VIII.—HABITS OF THE PORCUPINE (*HYSTRIX LEUCURA*)

This Porcupine, like the Hedgehog, is commonly found tenanting the crevices in the lime stone conglomerate of the hilly area in Tatta, Karachi District, Sind. The main point of this note is to illustrate the fact that the Porcupine shares with the Rhino and some of the deer the habit of resorting to the same spot to deposit its excreta. The place is visited night after night by these animals resulting in a cone shaped accumulation of excreta which in one instance measured about a foot and a half high and a yard across. The animals are exceedingly shy of traps and avoided the spot when I set traps around it—as I was able to judge from the condition of the droppings when I visited the spot the next morning. I strewed pieces of potato over the heap to attract them and laid traps afresh but with no better results. The next night I removed the traps and placed a fresh stock of bait which was immediately consumed. I might say that the traps were in each instance buried and yet the animals easily detected their presence.

BOMBAY,
April 11, 1927.

C. McCANN.

IX.—A WHITE ELEPHANT CALF

Reprinted from the 'Field' of December 16, 1926

Much interest has been aroused recently in this district by the birth of a supposed white elephant calf to one of the Borneo Company's timber elephants working teak in the Muang Fang Forest, north of Chiengmai. The calf was born on May 6th last and rumours at once spread among the native population that it had the attributes of a true white elephant, and this reaching the ears of the Chao Luang or Chief of Chiengmai and the Siamese Commissioner here, the calf and its mother, at their request, were brought down to Chiengmai, where the calf was pronounced to be a true 'Chang Peuak' or white elephant by local experts and entered the city in procession with the usual ceremonies. An official from the Royal White Elephant Department in Bangkok was also sent up to inspect the animal and report on it, and I am informed that his verdict supports that of the local elephant 'mors' or experts. The chief 'points' looked for, in such elephants, appear to be (1) a light red skin, the lighter the better, with still lighter coloured patches on belly and inside of legs; (2) white hairs on body and tail; (3) a very light pink palate or roof of mouth; (4) eyes a light bluish-pinky colour; (5) white toe nails. The number of toes does not seem to matter materially, but five on each foot, fore and hind, is considered, I believe, a mark of high caste. The calf with its mother, has been handed over by the Borneo Company to the Chao Luang of Chiengmai to look after, pending the visit of His Majesty the King of Siam to Chiengmai in January next when it will be inspected by him.

THE BORNEO COMPANY, LTD.,
N. SIAM.

D. F. MACFIE.

X.—TWIN ELEPHANT CALVES

(*With a plate*)

The following will correct inaccuracies contained in note No. viii, p. 813, of vol. xxxi, No. 3.

The twin elephant calves referred to by Major Stockley were born in June 1920, and 'other' calf in September 1921, so that the latter is some fifteen months younger than the twins and not older.

The 'other cow' elephant had produced four calves at the time Major Stockley saw her, not three only, and she has now another calf at heel born last month. This dam was about twenty-five years old when I saw her first and she may have produced other calves before this, of which I know nothing.

The twins at birth measured 2′ 10″ at the shoulder each whilst the other measured 3′ 1″.



THE TWIN ELEPHANT CALVES IN HARNESS.

(*Miscellaneous Note No. X.*)

All three are now ' in harness ' and their measurements are as follow :—

Male twin, aged say 6½ years, height	5′ 9″,	girth 9′	neck girth 5′ 5″.
Female twin	5′ 8″	8′ 1″	4′ 10″.
Other calf (female)	5′ 7″	8′ 10″	5′ 5″.

I had intended to send you a series of photographs of the twins but have been unable to put my hand upon all the necessary films. These contain also one film showing three generations.

C/o STEEL BROTHERS & CO., LTD., GORDON HUNDLEY.
RANGOON CAMP,
January 2, 1927.

[Since this note was written we have received a number of very interesting photos from Mr. Hundley of the twin calves, two of which are here reproduced. EDS.]

XI.—SOLITARY COW GAUR

With regard to Mr. Salim A. Ali's experience with a solitary cow gaur (*vide* note No. viii, vol. xxxi, No. 2), the only case of a solitary cow gaur I have ever come across occurred some years ago. I was asked by some Sholagas of these hills to shoot a solitary ' bull ' bison which was giving trouble near their ' podus ' in the tract of jungle (a Jaghir) they lived in. I had no difficulty in doing this—but found to my surprise that the solitary was a cow. It was very emaciated, and was evidently suffering from some disease. I learnt from the Sholagas that it had been in the same neighbourhood for three or four years but had only a short time previously commenced to be aggressive, probably due to increasing ill-health.

ATTIKAN P.O., MYSORE, RANDOLPH C. MORRIS.
January 1, 1927.

I was very interested by the note on the solitary cow gaur by Mr. Salim A. Ali in the last issue, as two years ago I was ' stung ' in the same way. I had heard of a solitary bull near a village in the hills bordering the Nmai Kha, Upper Burma and went out after him. The first day I found large tracks of a solitary bison which I presumed was the bull, there being no tracks of any other bison in the jungle I had searched. I came up with the animal when its head was hidden by a clump of grass, but being a big beast and coal black I shot it. On examination I found it was very old and emaciated and I was astonished at the formation of its horns, which were the cow type but exceptionally large. On turning it over I was disgusted to find that it was a cow. I unfortunately did not measure the animal but it was as big as many shootable bulls I have seen. The measurements of the horns are :—Length of longest horn 27½″, girth 15″, span 28″, tip to tip across forehead 66¾″. The Kachins with me were equally astonished at finding a solitary cow like this. She was covered with scars, apparently from fighting, and I took two spherical lead bullets out of her, the wounds being quite healed up, also she had lost the end of her tail.

MYITKYINA, E. MAXWELL WEST,
November 25, 1926 *Captain.*

XII.—BISON AND CULTIVATION

Most shikar books emphasize the extreme aversion bison evince for the proximity of man.

There is an estate near here with a grass-jungle-topped hill rising about 400 feet behind the bungalow. From the hill people are of course clearly visible around the bungalow and every sound therefrom is clearly audible.

This hill is the favourite resort of what my friend the owner of the estate, calls his ' tame herd ' and which he never molests. They constantly come out on that hill, usually in the early morning, and graze till about 9 a.m. As recently as this morning (I had been over for the night) we counted a sizeable young bull, 7 cows and 3 young calves. This is an increase of 4 in the last 2 or 3 years.

NELLIAMPATHIES, A. P. KINLOCH, F.Z.S.
January 10, 1927.

[There is a record in the Society's Journal of a pair of Gaur appearing on the rifle range at Kamptee, C. P., during musketry practice. One of the beasts made off in the direction of a neighbouring village while the other, after an eventful chase, was shot in Kamptee Bazar. Mr. Dunbar Brander who comments on the incident in 'Wild Animals in Central India' states that the animals were by all accounts trekking from the Chanda Forest to the Satpura Hills. He mentions two old bulls which he bagged with a right and left when leaving a village tank in Chanda. EDS.]

XIII.—WORN DOWN TIPS OF BISON HORNS

Dunbar Brander, among other writers, records that old bull bison (Gaur) use their horns as implements, with the result that their horns are worn down considerably. I cannot believe however that the wearing down of the tips of bison horns as one sees in old bulls, is entirely due to this and I think that it is due mostly to a failure of lamination after a certain age, and a close examination of heads with worn horns has strengthened my belief in this.

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE, RANDOLPH C. MORRIS.
April 4, 1927.

XIV.—A FINE MUNTJAC

I send some photos of a fine muntjac shot by Major G. L. Lamotte, D.S.O., at Woodroffee Estate, Nilgiris, on April 16, 1910.

	Left horn.	Right horn.
Girth ½ way up	$3\frac{1}{4}''$	$3\frac{1}{2}''$
Length of horn	$6\frac{3}{4}''$	$6\frac{5}{8}''$
Pedicles	$3\frac{1}{2}''$	$3\frac{1}{2}''$
Girth above burr	$4\frac{1}{8}''$	$4\frac{1}{8}''$
Spread	$6\frac{5}{8}''$	

NELLIAMPATHY HILLS, A. P. KINLOCH, F.Z.S.
January 10, 1927.

[Rowland Ward's 'Records of Big Game' give $7\frac{5}{8}''$ as the length of horn of the best Indian Head. It was obtained in the Siwalik Hills, U.P.—Dunbar Brander mentions a head of 7″ secured by him in the C. P. The photos unfortunately are not suitable for reproduction. EDS.]

XV.—'CLICKING NOISE' MADE BY MUNTJAC

In Miscellaneous Note No. I, vol. xxxi, No. 1, Lieut.-Col. R. W. Burton asks whether I have heard the clicking noise (which I described in Miscellaneous Note III, vol. xxx, No. 3) made by muntjac when moving quietly away at a walk. I have, and I have found that chital seem to make this noise more than muntjac or sambhur. I have had several of these animals together tame, and the quiet clicking sound they made as they walked round inside their enclosure was very noticeable. The noise was undoubtedly made by their feet, and gave me the impression that their lower joints were stiff. This clicking, however, is not the noise I have previously described which is very much sharper and louder, and *only* made by the muntjac as it *bounds off*. Where muntjac are as numerous as they are in these parts this noise is heard with great frequency and I cannot understand how it is that Col. Burton has not heard it himself: unless it is a characteristic of the muntjac on these hills only, which is highly improbable.

ATTIKAN P.O., MYSORE, RANDOLPH C. MORRIS.
December 18, 1926.

XVI.—PECULIAR CRIES EMITTED BY SAMBHUR STAGS FIGHTING

I recently watched a couple of sambhur stags fighting, and was struck by the extraordinary sounds they made. I was sitting on a hillside overlooking a Shola and first heard the cries in the Shola itself, and the noises somewhat

resembled the whines of a pack of wild-dogs fighting over their kill, and I was preparing to descend to the Shola when out came two small stags and immediately commenced fighting in the open, and at the same time, emitting the cries described above. A better description perhaps would be the squealing of large puppies half playing and half fighting. The stags were not worth shooting, and I spent a most interesting hour watching a prolonged series of bouts accompanied by these strange sounds, which I have not heard sambhur emit before.

ATTIKAN P.O., MYSORE, RANDOLPH C. MORRIS.
April 1, 1927.

XVII.—MATING OF THE JUNGLE CROW (*CORVUS CORONOIDES INTERMEDIUS*)

Seeing an article in the Miscellaneous Notes by Mr. Salim A. Ali, on page 823, vol. xxxi of the Journal on the above subject, perhaps the following may be of interest to some of your readers.

Some few years back I happened to go out very early in the morning for a ride round Jakko. It was about March 15, the time being 5.45 a.m. As I approached the Ladies' Mile I put my horse into a sharp steady trot, and had not gone many yards, when I noticed a party of Jungle Crows (about seven in number) in the centre of the road. As I drew near the birds, the majority flew out of my way, leaving just a pair of them who were in the act of copulation, this being the first time I had witnessed these birds in this act. On the 19th of this month (March), I got up very early the time being 5.30 a.m. to take my morning walk. Whilst dressing I chanced to look out of the window and I noticed two pairs of Jungle Crows, within a few yards of each other both pairs engaged in the above-mentioned act. The birds were on a flat cement roof just opposite my rooms. Prior to the act the hen-bird shakes her wings, exactly in the same manner as the young of most birds are apt to do when being fed by their parents. I have now been in Simla many years and have always taken a very keen interest in the ways and habits of birds, so that it would appear that the mating of these birds in particular only takes place soon after daybreak, hence it is so rarely observed.

SIMLA, ARTHUR H. BERRIFF.
March 22, 1927.

XVIII.—THE BEARDED TIT, *PANURUS VIARMICUS RUSSICUS* (BREHM)—AN ADDITION TO THE INDIAN LIST

In the wide bend of the River Indus between the old moribund town of Attock in the Punjab and the mouth of the Kabul River there is a large island sandbank on which grows a dense thicket of sarpat grass and tamarisk scrub; this thicket is at least half a mile long and about 300 yards wide and its average height must be 12 to 15 feet, and it is so dense that to force a way through it is a matter of great exertion and difficulty. Bare sands surround the thicket and these are edged with stretches of large stones and pebbles where they border on the channels of the river.

On December 30, 1925, I visited the island expecting to find that it was the home of *Argya earlii* and *Laticilla burnesi*. I wandered about in it for some time and could find no signs of bird life save for an occasional faint squeaking note which was not identified though I attributed it as probably a note of *Prinia gracilis lepida*. However while proceeding along a rough trampled cattle path that ran down the centre I suddenly came upon a number of Reed Buntings (*Emberiza schœniclus pallidior*) that were feeding on the tall seed heads of the sarpat grass, and under them a flock of Bearded Tits. There were eight to a dozen of the latter and they were perching in the clumps of sarpat and peering at me and calling. They were quite tame and I had no difficulty in obtaining three specimens before the party moved away.

Time was limited and a hasty search did not show the presence of any more parties but the thicket was so dense that anything in it was easily warned of my progress.

The specimens procured were a male and two females. Their organs were quite undeveloped, they were not fat and there was no moult. All had been feeding on the tiny seeds of the sarpat grass.

I searched the island again on February 28, but could find no trace of Bearded Tits. Mr. A. E. Jones visited the island on January 16, 1927, with some friends, one of whom saw and described a bird that may have been a Bearded Tit. Mr. B. B. Osmaston on my suggestion has also searched the reed beds of the Kabul River near Peshawar without finding any trace of the species. At present therefore it is difficult to say whether the birds I saw were residents or stragglers from further north. It is usually regarded as a strictly sedentary species and it very easily escapes notice from the nature of its habitat so I still hope that ultimately it may be found to be a resident in the extreme north-west of India.

The specimens procured belong to the pale eastern race *Panurus viarmicus russicus* of which there is a good series in the British Museum from E. and W. Turkistan (Ferghana, Tianshan, Yarkand, Lobnor) and Mongolia; these are the nearest localities to Attock in which the species has been hitherto recorded and it is difficult to see how birds of this type could have crossed the Karakorum into the watershed of the Indus as mere stragglers. They are known to be resident in the swamps of Turkistan.

BATTLE, SUSSEX, HUGH WHISTLER.
February 11, 1927.

XIX.—OCCURRENCE OF THE PAMIR HORNED LARK (*OTOCORIS PENCILLATA ALBIGULA*) IN THE PUNJAB

On March 1, 1926, I was motoring into Rawalpindi from the direction of Attock when we disturbed a Horned Lark which was feeding on the road about 2.30 p.m. This was between Serai Kala and the Nicholson monument at Margala at an altitude of about 1,800–1,900′. It settled on barren ground at the side of the road and we stopped the car and went back to look for it. It was fairly tame and allowed me to get within 10 or 15 yards of it several times, merely rising and flying round with a strong rather swaying flight to settle again in the vicinity. The unbroken black gorget was very marked in life. I secured the bird and found it to be a fine male of the Pamir Horned Lark *Otocoris penicillata albigula* which is said to swarm in winter in Gilgit down to about 5,000′, but does not seem to have been procured south of that locality.

BATTLE, SUSSEX, HUGH WHISTLER.
November 2, 1927.

XX.—THE ROCK-SPARROW (*PETRONIA STULTA*) IN THE PUNJAB

When writing in vol. xxx of our Journal on the Finches of the Punjab I was unable to include the Rock-sparrow in my list as all the Indian records related to localities north and west of the Provincial boundary. It may now, however, be included in the Punjab list.

On December 30, 1925, I was staying at Attock and walked down to the edge of the Indus from the Public Works Department Rest House that overlooks the river. On the patch of rough sandy ground studded with Bir trees that lies at the foot of the Rest House knoll I disturbed a party of twelve to fifteen birds which flew down and settled amongst the reef-like rocks that line the shore of the river. They were rather shy and rose and settled again two or three times amongst the rocks before flying away to the hills behind the Rest House. Although I failed to secure a specimen I had a good view of the party with the glasses and was satisfied that they were Rock-Sparrows a species that I know well in Spain, Corsica, and the Pyrenees.

BATTLE, SUSSEX, HUGH WHISTLER.
November 2, 1927.

XXI.—THE MATING OF PAROQUETS

On the morning of February 27, at Cambay, I had the opportunity of observing for the first time a pair of the Rose-ringed Paroquet (*Psittacula torquata*) in copulation, and in view of the extraordinary antics indulged in by the birds—especially the cock—I think the following note will prove of interest.

I was staying in a somewhat crowded and antiquated part of the town, where the holes in the ancient walls provided excellent nesting sites for Mynas—Common, Bank and Brahminy—besides numerous Rose-ringed Paroquets. Close to my window was an electric wire post and on this the sundry occupants of the holes were to be seen at all hours of the day.

On the present occasion a pair of paroquets were sitting on the cable close to one another paying delicate attentions in the way of tickling each others heads and so on. In a little while the male sidled up closer to the female who responded by squatting herself flat, neck extended in front, flattening her back by slightly opening and raising her wings. The cock-bird now complacently climbed on to the hen's back with the help of his beak and there commenced a series of some extremely odd proceedings, difficult to describe. At first he kept to the left side of the females back only and commenced jerking his head up and down so that at each downward stroke of the head the culmen of his beak rubbed against the left side of the hen's head. After twenty jerks or so in this manner, he stepped over to the right half of the female's back and the jerking of the head was repeated, this time the culmen stroking the right side of her head. In the course of these proceedings the female frequently turned her head round and touched the cock's beak with hers.

This performance continued for fully five minutes. The cock now shifted himself to the centre of his spouse's back and with his wings open and drooping low on either side of her, tilted himself backward and the act was accomplished.

During the half hour I was watching the pair, copulation took place thrice, the birds moving off a little distance after each act, and sidling up again after a while. The last two 'transactions' occupied a much shorter time than the first.

It would appear that early morning is the time selected by the birds for this phase of their nesting operations, as though they kept to the neighbourhood throughout the day, no more of the business was noticed.

BOMBAY NATURAL HISTORY SOCIETY, SALIM A. ALI.
6, APOLLO STREET,
March 1, 1927.

XXII.—HABITS OF THE INDIAN SPUR-WINGED PLOVER (*HOPLOPTERUS VENTRALIS*)

1. *Protective devices.*—The Indian Spur-winged Plover haunts the sands in river beds. It has the plover-like habit of making forward rushes, then short halts during which it often stands on one leg.

It makes remarkable use of its protective colouring and behaves as if it understood the advantage of its dress. The following are the parts of its colouration which concern us. Its back is sandy brown, under parts white, crown black with a long crest throat with a black patch, wings largely black and white. The black and white of the wings would be very conspicuous were it not that when folded these colours are hidden by the inner coverts which are coloured light brown.

A bird clothed in this striking dress is certainly very obvious when in flight. It is equally conspicuous against a dark background or when standing on green grass. But the spur-wing keeps mainly to river beds, and so conducts itself in the face of danger that its colours blend remarkably with the sand. At the edge of the water it is conspicuous enough, for the sand is there wet and dark owing to the moisture sucked into it from the stream. And the spur-wing seems to know that the edge is dangerous, for, on my approach, it runs inward to the drier area where its light brown plumage blends with the paler sand.

Let us approach closer and watch how the bird behaves. It reaches the paler tract of sand, then halts, bends its legs, dips its head, depresses it crest, and lowers its body close to the ground. Its gait, if it moves, is very stealthy, and it is obviously trying to make itself look small. Sometimes it crouches very low and flattens its body down on the sand. Perhaps it may find a small hollow in which it can conceal itself completely from view. Thus the spur-wing seems to know that it must make itself inconspicuous, that its safety is secured by blending with the sand.

Other plovers adopt this ruse. The Little Ringed Plover, *Ægialitis dubia*, for instance, sometimes crouches in a similar way. It likes sandy places and is protectively coloured. Hence crouching conceals it in the same way as it does the spur-wing.

But the spur-wing shows other points of interest. If we try to make a circle round the crouching bird we will notice that it stubbornly refuses to face us. It will not show its breast. If it runs to another spot it may turn its tail to us, but its main object is to present to us a flank. As we circle round the bird turns also, with the result that we can get only a side view. If something forces it to turn the opposite way and make it present its head towards us, then it makes the movement sharply and rapidly, and we see it head-onwards only for an instant. Clearly the spur-wing will not face us, but compels us to look on its flank. The reason is that the bird is trying to conceal its most conspicuous part. Its black throat and white breast would be visible on the sand miles away. Its side view is a perfect blend. By the way in which it crouches and dips its head it manages to conceal its neck and throat partially, but it cannot hide them altogether. Hence the determination to show only a flank.

The Red-wattled Lapwing makes some attempt towards this same flanking ruse, like the spur-wing, its breast is the most conspicuous part. Its upper surface is dark brown which blends fairly well with the ploughed fields which this plover is accustomed to haunt. But if it is disturbed by someone approaching, it usually turns so as to present a flank. And if the observer makes a circle round it, the lapwing will repeatedly adjust its position so as to show only a flank.

Another point about the spur-wing's behaviour is this. While it is in the crouching attitude we notice that from time to time it gives its head a quick jerk. The act is momentary. Only for an instant is the head elevated, then It is immediately drawn down. This behaviour is linked with the protective attitude. For when the bird is crouching with head lowered so as to conceal the breast then its range of vision is much reduced. It must, however, watch the intruder. If it stands erect it makes itself conspicuous, and its main object is to avoid this. So it jerks up the head, takes a momentary glimpse at the intruder, then pulls the head down again. By so doing it makes the shortest possible exposure, and gets black to the protective attitude once more.

Thus we see that the spur-wing behaves as if it understood its protective disguise. The way it runs to the pale sand, the stealthy gait, the crouching attitude, the manner in which it persists in exposing a flank, the momentary glimpse that it takes with its head : all these are particular points of behaviour made to fit in with the colour scheme.

2. *Display.*—The spur-wing indulges in an interesting display which, had it occurred at another season, I would have associated with the sexual act. I observed it at the end of September. The swollen river had then shrunk leaving large patches of sand exposed. Spur-wings were accustomed to collect on these flats, sometimes in small flocks. Certain of these flats seemed specially attractive. One morning I saw a flock of spur-wings at one of these chosen spots. An unusual commotion was going on. Four of the birds stood apart from the rest. Three of them were making conspicuous display while the fourth seemed quite uninterested. They stood erect after the fashion of penguins, with heads thrust high in the air, breasts and white under parts ostentatiously exposed, especially the conspicuous transverse bands. In this peculiar attitude straight as a man upon his legs, they strutted about with an aspect of pride. Their affected gait was very amusing, the slow, measured, unnatural paces ; they looked as if showing themselves to best advantage at a kind of elaborate parade. Sometimes one would make a quick run ; the other two would immediately follow ; then the three would halt and start their strutting competition once more. At intervals they made bowing movements with their heads so as to hide momentarily the conspicuous breasts ; at other times they would spin themselves round in circles, making half a dozen or more turns. These evolutions were accompanied with clamour. The birds chattered continuously. It seemed as if a music competition was added to that of show. The fourth bird appeared to take no interest in the proceedings. It stood upon the sand a little distance away, balanced on one leg. Perhaps this uninterested spectator was the female ; but why should an ostentatious sexual display take place at this season of the year !

R. W. G. HINGSTON.

XXIII.—COMMENTS ON MR. J. K. STANFORD'S 'OCCURRENCE OF THE SHELDRAKE AND LAPWING IN UPPER BURMA'

Reference Mr. J. K. Stanford's note on the occurrence of the Lapwing in Upper Burma, published on page 823 of vol. xxxi, No. 3.

It may be of interest to you to know that Lapwing are quite numerous at Fort Hertz in Putao District, Upper Burma. In November 1923 I often saw as many as 20 in a flock on the grass fields bordering the Nam Palak and other neighbouring streams. They were very wary and I only managed to shoot one bird.

Capt. Fraser, who was at Fort Hertz, informs me that Lapwing were quite numerous during the cold weather of each year he was there. During the time I refer, to November 1923, I saw about half a dozen mallard, all drakes in full plumage, on the Nam Palak in company with a flock of Chinese Grey Duck. I shot three of the mallard and one Chinese Grey Duck.

The much lighter coloured throats of the latter were most conspicuous and the difference between the Burmese and Chinese variety of Grey Duck is very noticeable in this respect.

MANDALAY, UPPER BURMA,
December 31, 1926.

J. R. MUSGRAVE HANNA,
Captain,
Burma Military Police

XXIV.—OCCURRENCE OF SWINHOE'S SNIPE IN NORTH LAKHIMPUR

It may be of interest to the members of your Society to know that at a duck and snipe shoot got up by Capt. G. S. Lightfoot, Assam Rifles, at 'Demarjee' in North-Lakhimpur (Assam) a Swinhoe's snipe was shot by that gentleman on November 28, 1926, and further that of the 62½ couple shot, with the exception of one Painted and this Swinhoe's, all were Fantails.

I see that in Mr. Stuart Baker's book, he records one shot in 1903.

NAGAGHOOLIE, T. E.,
OAKLANDS P. O., DIBRUGARH,
ASSAM,
December 6, 1926.

W. M. LEMARCHAND.

XXV.—THE BREEDING OF THE SPOTBILL DUCK (*ANAS PŒCILORHYNCHA*)

On November 8 last I found a Spotbill duck's nest with eleven fresh eggs in it, and to-day, some eighty miles north of the place, flushed another Spotbill which had nine ducklings with her, not three days old.

I have also heard of a third brood being found early in this month, near Udaipur. The time of year seems rather out of the ordinary, so I report these dates.

It has been an exceptionally wet monsoon in these parts, and the amount of water about is quite out of the ordinary. So is the number of duck on the tanks. Nor, in the past four cold weathers, have I ever come across unfledged young of the Spotbill in the shooting season, here in Udaipur or anywhere else.

CAMP UDAIPUR, MEWAR,
December 8, 1926.

C. G. CHEVENIX TRENCH.

[The Spotbill frequently has two broods a year. According to Hume, in Sind it regularly lays in April and May and again in September and October. In Gujerat and further south eggs are laid later. Whitehead saw tiny ducklings in November at Sehore (Central India), and it is possible that what Mr. Chevenix Trench supposes was the third brood may after all only be a belated second. Under exceptionally favourable seasonal conditions however, such as mentioned by the writer of the note, there appears no reason why a third brood may not be produced and it would be interesting to have conclusive evidence on the point. EDS.]

XXVI.—OCCURRENCE OF THE SHELDRAKE IN BEHAR

On January 20, while out shooting in the Monghyr District of Behar, about five miles from Damana Station, B.N.W.Ry., one of the party shot a Common Sheldrake (*Tadorna tadorna*) out of a batch of six flying over. I think the occurrence of this bird is sufficiently rare to cause the shooting of it to be recorded in your Journal.

PAKSEY,
February 6, 1927.

P. MURPHY.

XXVII.—FURTHER RECORD OF OCCURRENCE OF THE SHELDRAKE (*TADORNA TADORNA*) IN BEHAR

In vol. xxxi, No. 1, I see an article No. 9 on the occurrence of Sheldrake in Bihar.

While I was Manager of Japaha Factory in the Bhicaupur Concern, on two occasions I had the Common Sheldrake brought in to me by duck-netters from whom I purchased the birds and kept them with wings pinioned for quite a long time. They used to roam *ad lib* about the garden.

Also on the Attara Chainpur Chanar in the Kattra thana elakka my brother Mr. P. G. Munns and myself have seen flocks of over 20 birds and have killed quite half a dozen or so during our stay in Bihar.

I have never seen them on any other Chanar nor heard of any more being seen in this District. In this Chanar I have also seen large flocks of Comb Duck, Lapwing and Curlew, which are also not very common birds in this part of Bihar. The Attara Chainpur Chanar is now nearly dried up and most of the birds seen there are now found on the Burthua Chanar, some two miles distance.

SOOGONG, SEGOULIC P.O.,
CHAMPARAN,
December 28, 1926.

F. A. C. MUNNS.

XXVIII.—MIGRATION OF WILD FOWL

Since the publication of the record of recoveries of ducks winged in Dhar State (Central India) in February 1926 by the late Maharaja on page 1034 of vol. xxxi of the Society's Journal we have received the following communication from Prof. B. M. Shitkow of the Zoological Museum, Moscow, through the courtesy of Major R. Seymour Sewell of the Zoological Survey of India.

The letter refers to a second duck obtained in Asiatic Russia, regarding which we had asked for fuller particulars.

'In reply to your letter of December 9, 1926, I have the pleasure to inform you that the duck mentioned in our letters (No. 38—*Anas penelope*) was killed on August 1, 1926, near the River Kargat in the environs of the station Kargat (Railway' Omsk,—Tomsk on the west of Nowonikolajewsk), approximately Lat. = 55½°, Long. = 80°. The duck was killed with young.'

This information is very interesting indeed. It is hardly permissible to draw conclusions at this stage, but the five records go to confirm the observations of other naturalists that the course taken by migrating birds is more or less directly north to south. In the case of our ducks the migration belt would appear to range between longitude 70° and 90°.

The distance between where the birds were ringed and where the last record comes from is approximately 2,300 miles in a straight line. Allowing for minor deviations on the route to circumvent natural obstacles such as deserts, high mountain ranges, etc., besides taking into account the fact that a great many birds go further down to the southernmost extremity of the Peninsula and into Ceylon, we would probably not be far out in conjecturing that many of our migrants must travel 3,000 miles or more each way. Additional interest is lent to this valuable record by the fact that the Pigeon killed was with young. Breeding marks the culmination of the outward journey and we would therefore consider this the most northerly point this particular bird was destined for.

Meagre as these records are, they show what important discoveries it is possible to make by employing the method of ringing wildfowl and we would appeal to all sportsmen in general, and to our sporting princes in particular to follow the lead given by the late Maharaja of Dhar.

We shall be happy to give any other information prospective experimenters may desire.

EDITORS.

XXIX.—LARGE FLOCKS OF THE COMB DUCK (*SARCIDIORNIS MELANONOTUS*)

Reference several notes on the size of flocks of Comb-duck, in 1925-27.

I came across large numbers of these duck in Bandelkund. On two occasions the numbers were very large. (1) On a tank with a village at one end and a

small hill at the other when the first shot was fired large numbers rose, flew round the tank and passed overhead. I counted upto 50. There were numbers of Brown Coot on this tank but no other duck or teal. (2) On a shallow tank the deeper end of which was surrounded by the huts of a village, a number of Comb-duck and Ruddy Sheldrakes were found on the mud at the shallow end. On the first shot the Sheldrakes flew off: the Comb-duck circled round several times and then perched on the tops of high *mahwa* trees which were growing round the village. I counted 25 on the trees and others had flown off. These duck looked very awkward on their high perches and struck me as unnatural.

DALTONGANJ,
PALAMAN DISTRICT,
December 15, 1926.

RODNEY FOSTER,
Major,
No. 1 Party Survey of India.

XXX.—A CASE OF SNAKE-BITE DUE TO CANTOR'S VIPER (*LACHESIS CANTORIS*)

Reprinted from 'The Indian Medical Gazette,' vol. lxi (No. 3, March, 1926)

Many cases of snake-bite are annually treated in the hospital at Haddo, but as is usual the snake is never brought for identification and the majority of patients have failed to observe any particulars, or characteristics of the creature that has bitten them. An exception to this rule however occurred on July 30, 1925, when prisoner No 32315 came to hospital after being bitten by a *Lachesis cantoris*, identified as such.

He had been bitten between the third and fourth fingers of the right hand at 3 p.m. on July 29. At nine o'clock that night he had severe vomiting which according to his statement was of a bitter greenish-coloured fluid. He had spent a sleepless night due to excruciating pain in the arm.

On arrival at the hospital (11.15 a.m. on July 30, 1925) the whole of the right arm was found to be very swollen, tense, and œdematous. Bullæ were found around the elbow joint, also posteriorly along the upper arm above, and the back and ulnar half of the forearm below. Temperature 98°, pulse 100, respiration 30; the patient was in great pain and was very restless. No abdominal pain was complained of nor was any tenderness elicited on palpation.

The pain extended up the arm from the fingers, then across the shoulder under the clavicle: also the course of the bullæ appeared to follow the line of the ulnar nerve, going up into the brachial plexus.

5 p.m.—Temperature 98°, pulse 98, respiration 20. There was a general reduction in the pain, and a slight abatement in the swelling around the shoulder. Patient was still restless. Suffered from constant eructation, the abdomen was slightly distended, and flatus was being passed. The bowels had not moved, but he had urinated twice. There had been no vomiting since admission. I am not certain whether the abdominal discomfort (eructation and flatulence) was due to involvement of the splanchnic nerves.

July 31, 1925.—Morning temperature 98°, pulse 88, respiration 20. Patient did not sleep till after midnight because of the pain. This morning he has none, but is still restless. The treatment adopted so far has been free incisions, and arm baths in a warm 5 per cent. potassium permanganate solution, one intravenous injection of calcium chloride (1 in 20), drinks of hot milk, and 2 oz. of rum b.d. A purgative of calomel grs. 6, followed by magnesium sulphate 6 drs. was also administered.

July 31, 1925 (continued).—Evening temperature 98·4°, pulse 84, respiration 20. Bowels were moved thrice after the calomel, the stools being loose and yellow, there is no flatulence now. Restlessness has also gone. There has never been any epistaxis or sub-cutaneous hæmorrhages.

August 1, 1925.—Morning temperature normal, pulse 86, respiration 20. The only swelling to-day is in the forearm and fingers, and that too is rapidly going. From to-day only antiseptic compresses are being used. The anxious expression has also left the patient.

Evening temperature 101°, pulse 92, respiration 22, benign tertian malarial parasites found in the blood.

August 2, 1925.—From this date onwards there is nothing further of interest to record about the case. No slough came away from the forearm and hand where the incisions had been made. The patient was finally discharged from hospital on August 20, 1925.

The course of the pain from the fingers upwards seemed to have travelled along the course of the ulnar nerve and then the brachial plexus. I think it possible that the abdominal discomfort, flatulence, distension and eructation may have been due to involvement of the splanchnic nerves, but why so long after the bite I cannot understand.

From the notes on the case it will be seen that the respiration and pulse were both slightly accelerated. How much fright accounted for this cannot be said. That there should have been no sloughing is also a point to note. One other common snake in these Islands is the *Lachesis purpureomaculatus* (Gray's pit viper), and I am hoping before long to have the opportunity of recording the effects of the poison of this viper also.

Postscript.—Since writing this article I have been in correspondence with Colonel F. Wall, I.M.S., who is of the opinion that the three snakes *L. gramineus*, *L. purpureomaculatus* and *L. cantoris* can hardly be considered distinct species, and that the two latter are merely insular forms. A careful analysis of the lepidosis of the three shows only differences in the scale rows.

A. BAYLEY-DE CASTRO,
Junior Medical Officer, Haddo, Port Blair.

XXXI.—SNAKES OF SHOLAPUR

I give below a list of the snakes found in Sholapur during the years 1923-1926, as you would like to have a record of them in the Natural History Society.

2. The late Mr. R. E. Macpherson of the Laxmi Mill in Sholapur, who was a keen shikari and a naturalist had made a collection of some snakes in Sholapur in the years 1912 to 1914. He had sent these to the Bombay Natural History Society for identification. They were the following :—

Eryx conicus	2
Macropisthodon plumbicolor	10
Dipsadomorphous trigonatus	12
Lycodon aulicus	5
Simotes arnensis	2
Oligodon subgriseus	2
Tropidonotus piscator	1
Coluber helena	1
Naia tripudians	3
Bungarus cœruleus	1

3. I have been here as Civil Surgeon since 1923 and during the four years though no special attempts were made to catch or collect snakes, a good many were brought to me, since it was known that I was interested in them. The following species mentioned before were seen and found. They were :—

Macropisthodon plumbicolor	3
Dipsadomorphous trigonatus	5
Lycodon aulicus	9
Simotes arnensis	5
Tropidonotus piscator	1
Coluber helena	7
Naia tripudians	5
Bungarus cœruleus	1

4. Many of the *Lycodon aulicus* brought to me were killed or found in the compound of the Civil Hospital or that of the Civil Surgeon's Bungalow.

5. *Coluber helena* appears to be a very common snake, not only here, but also at Pandharpur. A few dozen live snakes were caught in 1925 at Pandharpur and sent to you to prepare casts for the Prince of Wales' Museum, Bombay. Nearly two-thirds of these were *Coluber helena*. Sholapur is about 1,800 ft. sea-level. (*Coluber helena* is usually found above 1,500 ft.)

6. In addition to the above, the following species not recorded by Mr. Macpherson were seen :—

Typhlops sp.?	4
Lycodon flavomaculatus	1
Zamenis mucosus	3
Lycodon striatus	1
Vipera russelli	4

7. *Lycodon flavomaculatus* and *Lycodon striatus* were identified at the Bombay Natural History Society and some others were sent there also to confirm their identification. The *Typhlops* were killed in my bungalow and in the hospital.

8. The Russell's Viper was not known as occurring here to the present European Officers in the station. One beautiful specimen with black *hollow* rings on the back, was brought to me killed in the fodder stacked for Municipal bullocks on May 26, 1926. On July 19, 1926, a baby Russell's Viper 10″ long was seen and killed at about 8 p.m. in the verandah of the Officers' club where table-tennis is played. It was expected that the parent would be somewhere near. It was a curious coincidence that a big Russell's Viper (female) was killed in the open place in front of the District Judge's Bungalow near the club on October 3, 1926, and the District Judge, Mr. Broomfield, I.C.S., told me that an exactly similar snake was killed in his bungalow compound on October 10, 1926. This probably was the male. The bungalow has a cactus hedge round it.

9. Two other species should be added as occurring in Sholapur. These were found in January this year. In the big Sankrant Fair held here, there was a local snake charmer exhibiting snakes. He had 2 specimens of *Dryophis mycterizans* which were seen by me on January 19, 1927. He said he caught them in a field about 4 miles from here. The other is an *Echis carinata* (Phoorsa) which was seen and killed in the hospital verandah at 8 p.m., on January 25, 1927. It was very clearly marked specimen 16 inches long and looked fresh as if it had recently cast its skin.

SHOLAPUR, K. G. GHARPUREY, *I.M.S.*,
February 21, 1927. *Lt.-Col.*

[Lt.-Col. Gharpurey makes no mention of a saw-scaled viper (*Echis carinata*) obtained by his collector in the Sholapur District and brought down to Bombay. Our recollections of it are still very vivid as we took it out of the bag which it shared with other perfectly innocuous snakes! EDS.]

XXXII.—LARGE BROOD OF EGGS OF THE CHECKERED WATER SNAKE (*NERODIA PISCATOR*)

An example of the Checkered Water Snake (*Nerodia piscator*) was sent to us on March 22, by Lt.-Col. F. P. Mackie, I.M.S., of the Haffkine Institute, Bombay. The snake shortly after her capture laid 88 eggs. The eggs were not free but adhered to each other in a mass by means of a sticky fluid apparently secreted by the oviducts of the parent.

This is possibly the largest number of eggs in one brood recorded of this species. The eggs are soft shelled creamy white—not glossy—and the average measurement is $1\frac{1}{20}″ \times \frac{7}{20}″$.

BOMBAY NATURAL HISTORY SOCIETY, S. H. PRATER.
April 11, 1927.

XXXIII.—NOTES ON THE LIFE AND HABITS OF THE COMMON CARPENTER BEE (*XYLOCOPA AMETHYSTINA*)

The following notes were made on this small Carpenter Bee (20 mm. in length) in the Palni Hills (7,000–8,000′) of Southern India.

During the months November–January a few males, sex recognizable on account of yellow clypeus, were seen about in the broken and scattered rhododendron outside the pine plantations along the top of the steep southern escarpment. No females were seen and no nests looked for.

In February–March females were seen cutting out passages in the rhododendrons. Dry branches from 1 to 2 inches in thickness were selected.

The opening is as a rule on the lower or sheltered side of the branch and the burrow first made downwards. Edward Step, F.L.S., has stated that a second entrance or rather exit, is made at the lower end, but this is not the case with *Xylocopa amethystina* which has a much more curious arrangement to which I shall return.

The material was thrown out and allowed to blow away. When the nest tunnel was complete, material to close the bottom cell was taken from a new ' living room ' tunnel which was started upwards above the entrance. This upper tunnel was not kept at an even diameter like the nesting tunnel but often took a pear shape.

I opened a large number of nests in different states of construction and in every case found no sign of the upper ' living room ' tunnel until the first cell was constructed at the bottom of the nest tunnel. The greater the number of cells found complete so comparatively larger was the upper living room tunnel.

I conclude that the material from the living room tunnel was required for the partition placed above each cell but, of course, was unable to see the act. Cells numbered from six to ten the lower three or four first built, being noticeably larger than the top ones which ceased 1 to 3 cm. below the entrance. No signs of cells were ever seen above.

On March 8. I took two completed nests home for observation. Each had an elderly female sitting quiet in the entrance.

If a nest were watched for a few minutes and no traffic observed it was either complete or an abandoned old one. In the former case a light tap with a pencil would bring the owner to look out of the entrance hole. The black face of the female and her ragged edged wings and generally ' part worn ' appearance are sufficient to tell who she is and I imagine that my killing bottle did not anticipate nature by very long.

Of these two nests one top cell (the *last* completed) was opened sufficiently for me to see the inhabitant—a white larva—some 2 mm. long on a sticky yellow ball (pollen and honey ? sweet to taste but not agreeably so).

On April 4. Inspection showed a yellow colour and signs of wings and legs which were darkening on April 25.

On May 12 a male with wings undeveloped broke down the composition partition and emerged. My observation hole was made by removal of a replaceable bit of side of tunnel and had not touched the partition.

From 13 to 16 my victim walked about the stick in a slow and sickly manner, often returning to his cell and sitting looking out of the opening. The wings did not develop and he died on May 17 having refused to look at the various forms of food offered.

The inhabitant was large and on May 24 legs were black. This, a female, died immature in the cell on June 19.

I presume that in spite of my careful handling and attempts to maintain the natural angle at which the branch had stood, that movement had been too much for those that died. But the two that lived explained the absence of the lower exit door to nest tunnel. It is a case of ' the first shall be last and the last first ' and I shall be very pleased if any one can tell me how it is done. How exact must be the arrangement that allows these beasts to arrive at maturity in inverse order to that of their production as eggs, for if one arrived at maturity out of turn it would probably not be able to break down the obstruction caused by brothers whose order of precedence was attacked, even if the motive force would drive it to attack a second partition where one only is normal. Such an accident would raise an obstacle against the sisters whose turn was still to come and probably destroy the whole brood.

Further observation brought confirmation.

The nest is completed in about seven to ten days. Average number of cells eight. The imago appeared in strict inverse order to the egg The last laid egg and first imago were male and the first laid egg and last imago were female. Where sexes were not divided the extra one was generally a female. When the extra one was a male there were over the average number of cells in the nest. The appearance of the imagos from a nest completed in ten days was spread over some six weeks or more.

Xylocopa amethystina is a friendly bee easy to watch and very interesting. The larger size and black face of the female and the yellow clypeus on the face of the male making the sexes easily distinguishable. Fabre, on wasps, remarks on the larger cell and food supply and longer grub life required to produce the female, more—robust to perform her harder work than the male—whose business it is to be there ready to function when she appears.

But how is it done ? It cannot be a matter of larger cell and more food only

During June and July I examined a number of nests, best found at this time by lightly tapping likely looking branches, an answering buzz giving every

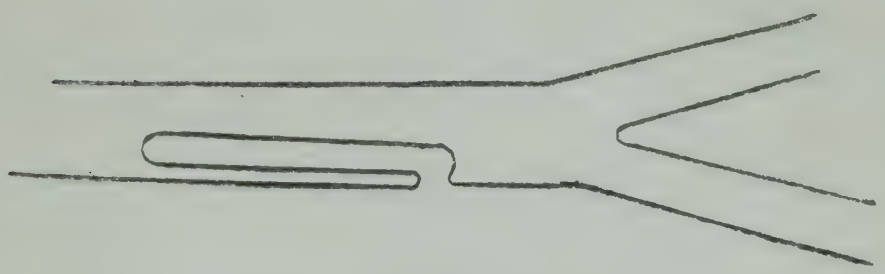


Diagram A.

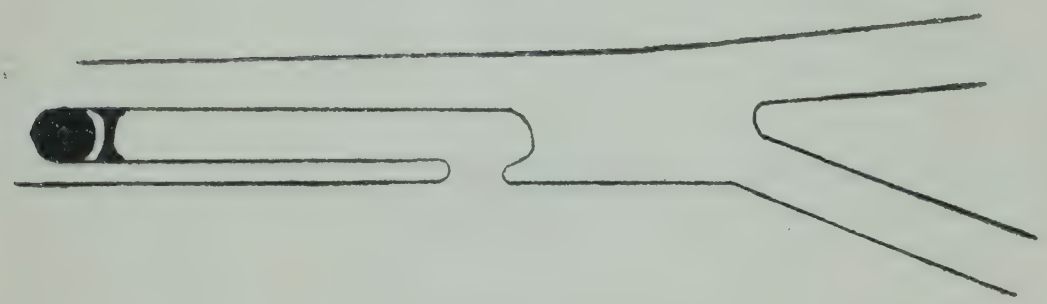


Diagram B.

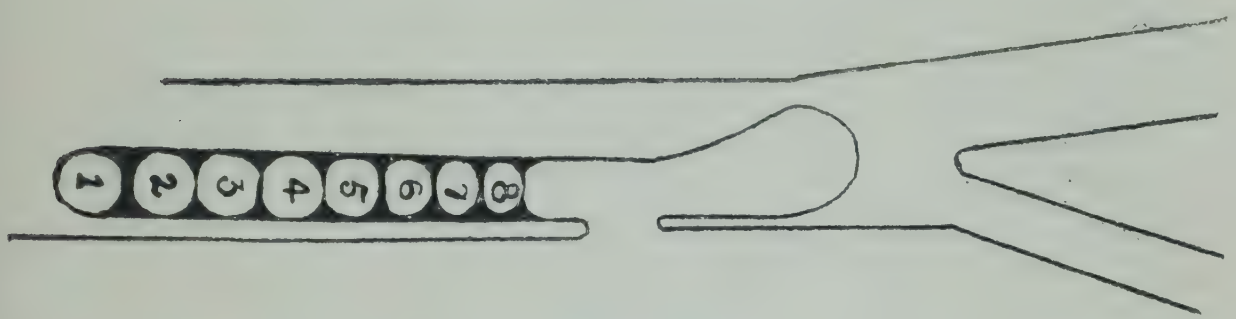


Diagram C.

Diagram A.

Nest under construction, a cylindrical tunnel downwards with the grain. Rounded at bottom (i.e., working surface). Entrance on lower surface of branch.

Diagram B.

First cell completed with ball of food and first partition made of material taken from above entrance.

Diagram C.

Nest complete with 8 cells and 'living room' from which material for partitions has been taken. The adult emerges in inverse order to the building Nos. 8, 7, 6, and perhaps 5 being male and Nos. 4, 3, 2 and 1, the last to emerge being female.

Nothing happened for a week, so I opened all cells and all inhabitants were dead but one in the bottom cell (note :—the FIRST cell completed).

thing away. Tie a leaf over the entrance or stick a rolled one in the hole and you have the members of the family who are at home, at your pleasure.

The following points were noted.—

As each cell is opened the debris is cleared out. I never saw this being done but I never found any debris in the tunnel. The partition is so completely removed that one can feel no signs of it but it leaves a dark mark on the wall of the tunnel so that one can count how many cells a nest has contained. The family does not desert the nest on emergence from the cell. One sees members coming and going. I have taken four to six individuals of both sexes at the same time in the same nest using the lower nesting tunnel and upper living tunnel as a communal residence, sometimes with immature individuals always females in the yet unopened lower cells. Their fresh and brisk appearance is very different to the elderly female builder of the nest. They were seen to visit flowers in the neighbourhood and I presume that the community sheltered in their snug nest through the rains and cold weather until the opening of the season again in the following February. I saw no act of mating throughout the year.

CANNANORE,
December 13, 1926.

A. G. FRERE,
Major, F.Z.S.

XXXIV.—NOTES ON A COLLECTION OF BUTTERFLIES MADE IN JODHPUR AND MOUNT ABU DURING THE YEARS 1924, 1925 AND 1926

PAPILIONIDÆ

Byasa hector. Several specimens seen and a couple taken in Jodhpur during the rains of 1924. None seen subsequently in Jodhpur or at all in Mount Abu.

Byasa aristolochiæ. Exeedingly common in Jodhpur almost throughout the entire year. Rather rare in Mount Abu.

Papilio polytes romulus. Fairly common in Jodhpur and rather rare in Mount Abu. Have taken the *aristolochiæ* as well as *hector* form of female in both Jodhpur and Mount Abu.

Papilio demoleus. Very common in Jodhpur and fairly so in Mount Abu.

Pathysa nomius. I obtained a very poor specimen taken by one of the Lawrence School boys at Mount Abu in 1925. Am informed that in some years it is fairly common in the spring. Have never seen any myself however either in Mount Abu or Jodhpur.

Zetides agammemnon. Rare but a few specimens can usually be taken in October at Mount Abu. Not seen in Jodhpur.

PIERIDÆ

Delias eucharis. Have only seen and taken one specimen in two years in Jodhpur—uncommon also at Mount Abu.

Anaphæis mesentina. Very common in Mount Abu and Jodhpur. Some of the wsf specimens in Abu are very richly coloured both above and below.

Huphina nerissa. Very common in Mount Abu, less so in Jodhpur.

Appias libythea. Not seen at all in Jodhpur and rare in Mount Abu, but a few specimens can usually be taken in the early spring and also after the rains. In nearly all the females taken (both wsf and dsf) the upper portion of the rear half of the abdomen was found markedly red.

Catopsilia crocale. Common both in Jodhpur and Mount Abu.

Catopsilia pomona. Very common in Mount Abu—rather uncommon in Jodhpur.

Catopsilia pomona. ♀ *V. catilla.* Have seen a few specimens in both Mount Abu and Jodhpur, but they are rare in both places.

Catopsilia pyranthe. Very common both in Jodhpur and Mount Abu.

Catopsilia florella. Very common in Mount Abu and less so in Jodhpur.

Terias libythea. Uncommon in Jodhpur and none taken or seen in Mount Abu.

Terias venata. Common in Mount Abu and Jodhpur.

Terias læta. Common in Mount Abu and Jodhpur. I took one specimen in Mount Abu in which the ground colour was completely white.

Terias hecabe. Common in both Jodhpur and Mount Abu.

Ixias marianne. Very common in Mount Abu. None seen in Jodhpur. The female varies considerably both in size and markings, the ground colour of some specimens being strongly suffused with yellow.

Ixias pyrene. Almost the commonest butterfly in Mount Abu. None seen in Jodhpur. The type appears to be a local one as the females are practically exclusively white (I have only seen one yellow one in several years collecting), while in the male the base of 3 upf is yellow only in the dry season forms. In the wsf specimens the dark discal band practically cuts across the base of 3 upf.

Colotis amata. Fairly common in Jodhpur—uncommon in Mount Abu.

Colotis protractus. Not seen in Mount Abu. Common during the late autumn and winter months in Jodhpur.

Colotis vestalis. do. do.

Colotis fausta. I have seen a few specimens in the late autumn in Jodhpur but never succeeded in taking any. Have only come across one specimen in Mount Abu.

Colotis etrida. Fairly common in Jodhpur and less so in Mount Abu.

Colotis danæ dulcis. Fairly common in Jodhpur—am told it is also occasionally taken in Mount Abu but have never come across any myself.

Danaidæ

Danais limniace. Very common in Mount Abu, and also found during the rains in Jodhpur.

Danais plexippus. Fairly common in Jodhpur. Rather uncommon in Mount Abu.

Danais chrysippus. Exceedingly common in Jodhpur—rather uncommon in Mount Abu.

Euplœa core. Fairly common as a rule in both Jodhpur and Mount Abu but I did not see a single specimen during 1925 in Jodhpur.

Satyridæ

Mycalesis mineus polydecta. Uncommon in Mount Abu. None seen in Jodhpur.

Lethe rohria nilgiriensis. Very common during 1925 in Mount Abu. None seen in Jodhpur.

Ypthima asterope mahratta. Very common in Mount Abu—rather rare in Jodhpur.

Melanitis leda ismene. Fairly common in Jodhpur and Mount Abu.

Nymphalidæ

Charaxes fabius. Rare in Mount Abu. None seen in Jodhpur.

Euthalia nais. do. do.

Pantoporia perius. Am told this species is quite common in some years during the spring in Mount Abu, but have never come across it myself either there or in Jodhpur.

Hypolimnas misippus. Fairly common in both Jodhpur and Mount Abu. The females of this species were exceedingly common in Jodhpur in the autumn of 1925 ovipositing all over the lawns of the Residency at a time when hardly any other butterflies (including *Danais chrysippus*) were flying.

Hypolimnas bolina. Very common in some years in Mount Abu, especially after the rains. In Jodhpur uncommon at all times. I have also noticed in the latter place that while the females are of the usual large type, nearly all the males are very small.

Precis hierta, *orithyia* and *lemonias*. These are all very common in both Jodhpur and Mount Abu, as is also *almana* in Jodhpur. I have come across very few of the latter however in Mount Abu.

Vanessa cardui. Exceedingly common in Mount Abu. Rather uncommon in Jodhpur.

Argynnis hyperbius hyperbius. None seen in Jodhpur and only one specimen (a female) taken during 1924 and 1925 in Mount Abu. This year, however, I have taken quite a large number of females and also a few males in the autumn in Mount Abu.

Atella phalanta. Very common in Mount Abu. Fairly so in Jodhpur.

LYCÆNIDÆ

Tarucus theophrastus. Common in Jodhpur but rather rare in Mount Abu.
Enchrysope cnejus. Common in both Jodhpur and Mount Abu.
Enchrysope contracts. do. do.
Chillades laius. Only one specimen taken but not recorded whether in Jodhpur or Mount Abu, probably Jodhpur.
Zizera trochilus putli. Common in Jodhpur—rather rare in Mount Abu.
Zizera maha maha. A few specimens taken in Udaipur but none seen either in Jodhpur or Mount Abu.
Zizera lysimon. Common in both Jodhpur and Mount Abu.
Zizera gaika. Common in Jodhpur, fairly so in Mount Abu.
Zizera otis decreta. Common in Mount Abu after the rains. None taken Jodhpur.
Syntarucus plinius. Common in both Jodhpur and Mount Abu.
Catachrysops strabo. Common in Jodhpur—apparently none taken in Mount Abu.
Lampides boeticus. Common in both Jodhpur and Mount Abu.
Nacaduba nora. Only taken in the spring in Jodhpur, none seen in Mount Abu.
Jamides bochus. Only 1 specimen taken in Jodhpur—none seen in Mount Abu.
Azanus ubaldus. Only taken in Jodhpur where common.
Azanus uranus. do. do.
Virachola isocrates. A very few specimens only taken during the spring of 1925 at Mount Abu—not seen since.
Rapala melampus. Very common in Mount Abu during the spring. I think I have also seen a specimen of this insect in Jodhpur but am not sure.
Spindasis ictis. Common during the autumn of 1925 in Mount Abu, none taken in Jodhpur or during 1926 in Mount Abu.
Spindasis vulcanus. do. do.
N.B.—A few other species of *Lycænidæ* were also taken but as I am uncertain of their identification I have not included them.

HESPERIDÆ

Badamia exclamationis. Common in Mount Abu.
Hasora alexis. Common in Mount Abu.
N.B.—I have seen either *Badamia exclamationis* or *Hasora alexis* also in Jodhpur but am not sure which species, probably the latter.
Suastus gremius. Common in Mount Abu. None taken in Jodhpur.
Baoris bada. do. do.
Baoris mathias. Common in Mount Abu, also in Jodhpur.
Baoris cotaca. Apparently only one specimen taken in Mount Abu.
Arnetta vindhiana. Common in Mount Abu, not taken in Jodhpur.
Telicota dara. do. do.
Hesperida galba. Rare in Mount Abu. None seen in Jodhpur.
Sarangesa purendra. Very common in Mount Abu after the rains.
Sarangesa dasahara. do. do.
Caprona ransonnettii. Rare in Mount Abu, none seen in Jodhpur.
Coladenia dan. Only 1 specimen seen and taken in Mount Abu. None in Jodhpur.
Udaspes folus. Only 1 specimen seen and taken in Mount Abu. None in Jodhpur.

A. D. MACPHERSON, C.I.E.,
Lieut.-Colonel.

XXXV.—THE OCCURRENCE OF THE WOOD MASON BUTTERFLY (*PARANTIRRHŒA MARSHALLI*) IN COORG

On October 3, 1926, I caught a single perfect example of *Parantirrhœa marshalli* on the Periyambadi Ghat Road, Coorg. This is of interest, as hitherto this very rare butterfly has only been recorded from Trivandrum, Travancore some three hundred miles away.

Although in the neighbourhood for a fortnight longer, I saw no further examples.

BANGALORE,
February 14, 1927.

H. C. WINCHWORTH,
Major, R.A.M.C.

[The record is of great interest and seems to show that this peculiar species may be spreading, since it was not obtained in Coorg by the late Mr. F. Hannyngton, whose list of Coorg butterflies is published in volume xxiv. EDS.]

XXXVI.—THE NORTH-WEST LOCUST IN SIND

The present has been a season in which, for the first time for a number of years, there has been very serious damage to many crops in Lower Sind by the attack of the North-West Locust (*Acridium peregrinum*). The damage was particularly serious in two areas, that on the east of Sind where as the result of unusually good rain the irrigated crops chiefly bajri in the desert portion of the Thar and Parkar district were better than is usually the case,—and that in the neighbourhood of Karachi, where the locusts swarmed down during the month of November, in swarm after swarm, and did a very great deal of damage to almost all crops that were standing. Though these were perhaps the two areas where the damage was greatest, yet there was very serious injury to crops up to about the latitude of Sehwan in Central Sind. Beyond that point northward no swarms were noticed, as far as I can hear. The cotton crops in particular suffered considerably.

My object in writing this note is, however, to draw attention to the behaviour of the swarms in Central Sind (Sakrand) not on crops, but on the jungle trees. In this area it is well known that in the jungle there is usually practically no herbage: all the vegetation consists of trees and shrubs. The swarms of locusts which came over near the end of November were in the swarming coloration. The direction they were taking was not by any means constant. In the jungle, to my surprise, the plant on which the locusts settled most abundantly was the leafless *Khirir* (*Capparis aphylla*). Nearly all the extremely abundant bushes of this shrub and tree were covered with them, and the ground round them was covered with them to an extent that no other part of the area was covered. They were vigorously gnawning the outer layer of succulent material from the green stalks of this plant,—and as a result, a few days later, almost all the shoots of many of these shrubs turned yellow and died.

The second plant which they seemed sometimes to attack in great abundance was the *Khabhar* or *Jhar* (*Salvodora sp.*), perhaps the most common jungle tree in this area. The young shoots were often completely defoliated on some trees only,—and the trees which the locusts favoured were in many cases so covered as to be weighed down as if covered with fruit. Only the leaves on the young shoots were usually taken and the trees seemed to be selected by the insects, for many of them were almost free.

Curiously enough, two other very common trees in this jungle,—the babul (*Acacia arabica*) and the *kandi* (*Prosopis specigera*), both of which were valuable fodder trees and which I should have expected to be relished by the insects, seemed hardly attacked, only a very few locusts were noticed sitting upon them. The same was the case with the species of *Tamarix* (Lai) which forms the other important constituent of this jungle.

I should be glad to know any other observations on the jungle plants favoured by the North-Western Locust, at the same or at other stages of their life history.

CAMP, SAKRAND SIND,
December 15, 1926.

HAROLD H. MANN,
Director of Agriculture.

XXXVII.—ON THE VITALITY OF THE CENTIPEDE (*SCOLOPENDRA*, sp.)

The following notes made by Prof. J. P. Mullan of the Department of Zoology, St. Xavier's College, are interesting and convey some idea of the vitality the centipede is notorious for possessing.

'September 23, 1926. Placed a living Scolopendra (Specimen A) in a cage.

September 24. In the same cage was introduced another living Scolopendra (Specimen B) slightly smaller in size than Specimen A.

September 25 In the morning it was found that Specimen A had devoured everything of Specimen P except the head with poison claws and the posterior portion of the body. The last four segments—(there are in Scolopendra about twenty-one segments bearing legs—) were intact. Everything within six segments preceding this portion had been eaten up leaving only the exoskeleton of these six segments.

On tapping the cage or touching this mutilated creature it was found that the legs of the last four segments commenced moving. I suppose it could have walked had it not been for the presence of the dead six segments in front of the living portion.

It remained in this condition for two full days (September 25 and 26). On the morning of the 27th no sign of life was visible.'

BOMBAY NATURAL HISTORY SOCIETY, SALIM A. ALI.
6 APOLLO STREET,
April 6, 1927.

XXXVIII.—THE POISON OF CENTIPEDES—BEING A SPECIAL REFERENCE TO THE ANDAMAN SPECIES

(*Reprinted from the Indian Medical Journal, June 1927*)

As I have had some experience, on the pathological effect of the poison of the centipede, both on human beings and animals, a short description of the phenomena will, I hope, be of interest.

The poison apparatus is formed by a modification of the first segment to form a pair of jaws, at the base of which is situated the poison gland, which communicates with the tip of the clawlike process by means of a duct.

The poison is an acid opalescent liquid, which has an intensely corrosive local action.

According to Castellani and Chalmers (*Manual of Tropical Medicine*, 2nd edition) 'Small children have been known to die from the effect of a sting, adults as a rule recover in about 24 hours at most.' On the first point I am thoroughly convinced of the great possibility of the fact, but on the second point I entirely disagree.

One of my cases, who was in hospital for three months is, at the time of writing still attending the out-patient department, with an ulcer, the result of a bite.

In India and Burma I have not known dire results to follow a bite, but the reverse is the case in the Andaman Isles, where I have seen specimens of centipedes varying from 7" to 13" in length and from ¼" to 1½" in breadth and from a light yellow to a dark greenish blue in colour. These facts I conceive to be proof of a great metamorphosis which has taken place due to natural environments. It is of some interest to note, that Burma, which is said to have been in some long by-gone days, connected with the Andamans and of which there is said to be some geographical proof, has centipedes not nearly so deadly as those in these isles, while the scorpionidæ there, are deadly, if I may so use the word, and they certainly are where children are concerned—are quite harmless here. There too the majority of scorpions met with are large and dark green in colour, here they are small and almost white. I have not come across many above 2".

There has been no single case in my hospital who did not develop intense lymphangitis with œdema and inflammation of the skin and subcutaneous tissue, and in most cases a localised necrotic process was started at the site of bite, while in other cases there was set up in addition to this a process not unlike the old time phagedenic ulceration.

I must confess that most of the cases received into my hospital were always several hours after the bite, but even then they invariably had some sort of 'first aid' treatment, such as an application of tr. iodine, or the rubbing in of crystals of pot. permang. after making a nick between the two punctures of the bite, so that there is no reason to believe that means for combating evil consequences were not adopted.

The man was bitten on the night of January 27, 1921, at 11 p.m., by 11.45 he was in the detention ward and had received treatment; but pain being very severe he was sent to me at 6 a.m. (January 28, 1921). On February 1, 1921, an enormous necrotic ulcer had developed. Apart from this, there was considerable lymphangitis, inflammation, and odema of the leg up to the middle of the thigh. Pain of a constant and gnawing character was now complained of and ordinary bromide and chloral draughts had little or no effect.

On February 3, 1921, a gangrenous sloughing process had started from the lower end of the wound to beyond and below the internal maleolus.

On the February 5, 1921, a good deal of the slough came away. At the time of writing this wound represents a healthy, clean, granulating surface, there was no pain or any constitutional disturbance.

It is said that the poison 'when injected into the veins of a rabbit causes an immediate paralysis with coagulation of the blood, while under the skin it forms a large abscess' (C. & C. *Manual of Tropical Medicine*, 2nd Edition). The effects of the poison, both local and general, are very pronounced and the development in symptoms can easily be followed stage by stage. Locally at first there is a simultaneous sensation of heat and tingling, which is rapidly superseded by intense pain, radiating up and down the limb. At the points of inoculation two red spots of blood appear, which, within 24 hours, enlarge and disclose a necrotic area. Lymphangitis, with odema, and inflammation extending as far down as the deep fascia, soon supervene and is a common symptom. At times inflammation of the lymphatic glands takes place, but I have not found the process leading to suppuration in any of my cases. The necrotic ulcer keeps enlarging till about the fourth day when it is circular or oblong in shape, exposing about 3" of slough with a further undermining of the skin for about 1" all round.

Occasionally, however, as in three of my cases, very extensive and rapid sloughing takes place. Once the slough is cast off or cut away, a healthy granulating surface appears, but the process of ultimate repair is slow. One of my cases was three months in hospital, is an out patient now for more than a month, but still has an ulcer about the size of an eight-anna piece. Another of the bad cases came into hospital on January 24,—at the time of writing this, March 1, 1921, he is still in hospital with an ulcer 2 in. in diameter, with undermined and unhealthy edges. This man had a rise of temperature for three days, the highest rise being 102·8° on January 25, 1921. In almost all the cases that have come under my personal observation, tissue destruction has been most rapid and extensive. A jailor who has been here for many years affirms this observation too, and instances one particular case of another European jailor who was bitten in the upper left arm and in 36 hours had a 4" sloughing ulcer, with excruciating pain of the whole arm and a high temperature.

The sloughing of the skin, subcutaneous tissue, fascia, muscle sheaths, and in some cases muscle fibres, is of a very acute necrobiotic process, while all the symptoms concomitant with an acute toxic condition are at the same time present.

Another point that is rather interesting is that in those cases in whom the phagedenic process was extensive, the pain was not of that extremely excessive nature as in other cases, but the patients were at times found to be in a dull semi-stuporous condition as was the case photographed. Some of these cases were undoubtedly of an acute gangrenous nature, and here probably a euphrobic condition was present. The ordinary general symptoms are hurried pulse, and slightly hurried respiration, headache, anxiety and pyrexia.

Apart from the knowledge gained in the wards, I carried out a few experiments, by causing live centipedes to bite, or, by injecting the poison with a hypodermic syringe. A record of some of these may be of interest.

A.—Guinea pig, female—bitten on the right shoulder by a large greenish yellow centipede at 10 a.m. Great restlessness, and whining—latter due to pain presumably. Noon: Great swelling and œdema extending up right side of face; 12.10 had a fit; 12.35 died.

B.—Guinea pig, young male, intravenous injection of the poison in saline solution. Developed a comatose condition almost at once. Died in $7\frac{1}{4}$ minutes.

C.—A frog injected with a solution of the poison developed no bad effects that were apparent, but 24 hours later the web of all four feet were noticed to

be black. When let out of his cage he croaked and hopped away quite unconcerned.

D.—Pup, 4½ months old, bitten on the upper lip. Rapid heart, followed by irregularity and slowing. Developed a stuporous condition. Intense cellulitis followed in 12 hours and in 2 days an ulcer developed which took more than 1½ months to be completely healed. The pup during this period was very ill. On one occasion she passed a few drops of blood in her urine.

E.—Duck, adult, bitten at 10 a.m. below left eye, was dead in ten minutes.

F.—Drake, old, bitten on left thigh. Developed paralysis of limb in about 10 minutes. Unable to stand and refuses all food. Looks ill, does not mind being handled. Lethargic. In the afternoon it shuffled away to a cool spot under a rose bush.

Next morning there was a nasty slough of the thigh. Antiseptic applied. Bird had to be fed.

Next morning a bit brighter, ate a little cocoanut pap, wound was thoroughly cleaned and all slough removed.

Recovery was uneventful, but up to date the bird limps.

Note.—Of course none of these phenomena are observed in the case of a bite from a young scolopendra, from whom I also failed to extract the poison.

As regards treatment, I have found nothing to be of any avail if the period between bite and active treatment is delayed beyond an hour. After that incisions, and antiseptic baths, or compresses will be found good, but before that the crystals of pot. permang. rubbed into the wound after making a small incision, is as effective as liq. ammonia, or a paste of liq. ammonia and pulv. ipecac.

Haddo, Port Blair. A. BAYLEY-DE CASTRO,
Junior Medical Officer.

BOMBAY NATURAL HISTORY SOCIETY

Proceedings of the Annual General Meeting held on March 8, 1927

The annual general meeting of the members of the Bombay Natural History Society was held on Tuesday at 6.15 p.m. in the Reptile Room of the Natural History Section, Prince of Wales' Museum. The Hon'ble Mr. J. E. B. Hotson, I.C.S., C.I.E., in the chair. One hundred and five new members were elected since the last meeting.

The appointment of officers for the ensuing year was as follows :—President —H. E. the Right Hon. Lt.-Col. Sir Leslie Wilson, P.C., G.C.I.E., C.M.G., D.S.O. ; Vice-Presidents—H. H. the Maharao of Cutch, G.C.S.I., G.C.I.E., the Rev. E. Blatter, S.J., PH.D., F.L.S. and the Hon. Mr. J. E. B. Hotson, C.S.I., I.C.S.

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The annual statement of accounts for the year ending December 31, 1926, were presented by Mr. J. B. Greaves.

Sir Reginald Spence, the Honorary Secretary, then introduced Mr. S. H. Prater, the Society's Curator on his return from his deputation to some of the larger museums of America and Europe.

Mr. Prater delivered a lecture on 'The Services of Museums to the Public' which was based mainly on the results of his studies and observations in Museums in America and Europe. The lecture was fully illustrated with an interesting series of lantern slides.

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OF THE

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THE EASTERN BAILLON'S CRAKE

Porzana p. pusilla

¾ natural size

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Bombay Natural History Society

October, 1927 Vol. XXXII No. 2

THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

Vol. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

Part IV

(*With a coloured plate*)

(*Continued from page 13 of this Volume*)

Porzana porzana

The Spotted Crake

Rallus porzana, Linn., Syst. Nat., 12th ed., i, p. 262 (1766) (France).

Porzana maruetta, Blanf. and Oates, iv, p. 166.

Vernacular Names.—Gurguri-khairi (Beng.); *Venna-mudi-kodi.* (Tam.).

Description.—Centre of crown, nape and neck and whole upper plumage rufescent olive-brown, each feather from crown to tail with broad back central streaks; hind neck and upper back spotted with white; the lower back, rump, upper tail-coverts, scapulars and innermost secondaries streaked narrowly with white; outer wing-coverts immaculate except along the edge; inner wing-coverts with arrow-shaped white streaks edged with black; inner secondaries the

same but with golden rufous margins to the inner webs; quills brown, the first primary edged with white; lores and round the eye blackish; a line behind the eye rufescent; supercilium, sides of the head and neck and whole breast grey, speckled with white and washed with brown across the breast; centre of chin and throat and abdomen white; flanks brownish-grey barred with white; vent and under tail-coverts buff; edge of wing white; remaining under wing-coverts and axillaries barred brown and white.

Colours of soft parts.—Iris reddish-brown to red; bill yellow, orange at the base and darker, more greenish at the tip and along the culmen; legs and feet bright olive-green.

Measurements.—Length about 200 to 220 mm.; wing 112 to 119 mm.; tail 47 to 52 mm.; tarsus about 33 to 35 mm.; culmen 19 to 21 mm.

Young birds are more brown below and have the white on the chin and throat more extensive.

Nestling.—Down all black.

Distribution.—Europe and West Central Asia. In Winter it migrates into Northern Africa and into India. It is not uncommon in Northern India from Sind to Bengal. Both Coltart and I found it in Assam and it has been recorded as far east as Arrakan. To the south it has occurred in Belgaum, and Jerdon stated that it occurred almost all over India but it is probably an exceptional visitor south of Bengal or to the east of Bombay in Southern India.

Nidification.—The Spotted Crake is only a migrant to India and it does not breed within our limits. In Central Europe it breeds principally during May and early June, but in Finland eggs may be taken as late as the middle of July. The nest is the usual rail-like affair of coarse grass and rushes lined with finer grass, placed in amongst vegetation around the edges of swamps, at other times in a dry patch in a marshy field and, less often, away from water in amongst long grass or standing crops. The eggs generally number 8–10 but frequently larger clutches are found, up to 15 having been recorded. The ground colour varies from greyish to greenish-buff and they are profusely marked all over with small spots and blotches of reddish-brown or purplish-brown with underlying spots of neutral tint and lavender grey. The eggs though quite galline in character can be separated at a glance from any of the other rails' either resident in India or migratory. The average of 100 eggs is given by Witherby as 33·62 × 24·57 mm., *maxima* 37·5 × 24·8 mm., 33·0 × 26·8 mm., *minima* 29·1 × 23·0 and 32·0 × 22·2 mm.

Habits.—Generally speaking there is little to record about the Spotted Crake which is different from that of its nearest allies. It arrives in North India in early October, the first few birds coming in some ten days earlier and they leave again in March or April. Like all the family it is a confirmed skulker and one but seldom sees it except when out Snipe shooting with a good line of beaters. It runs well, and in spite of the long distances it has to migrate, it is neither a very fast nor a very powerful flier. Like all the rails it swims well. Its food is both insects, small mollusca and worms as well as all sorts of seeds and shoots of aquatic inland plants.

Porzana parva

The Little Crake

Rallus parvus, Scop. Ann. I. His. Nat., p. 108 (1769) (Karnthen).

Porzana parva, Blanf. and Oates, iv, p. 164.

Vernacular Names.—None recorded.

Description.—Male: Centre of crown and neck dark, slightly rufous-brown ; remainder of upper parts more olive-brown, darkest on the rump ; upper back, scapulars and innermost secondaries with broad black streaks and a few narrow white streaks, these latter also extending to the lower back, rump and upper tail-coverts ; wing-coverts light brown ; quills darker brown ; supercilia, sides of head and neck, chin and throat and whole lower plumage rather dark ashy-grey, the extreme posterior abdomen, flanks and under tail-coverts banded brown and white ; under wing-coverts and axillaries light slaty-brown.

Colours of soft parts.—Iris red, brown in young birds ; bill green, the base red in summer ; legs and feet yellowish-green to dull pale slaty-green.

Measurements.—Total length about 200 mm. ; wing 95 to 106 mm. ; tail 50 to 60 mm. ; tarsus 90 to 31 mm. ; culmen 18 to 20 mm.

Female.—Supercilia and face paler grey ; chin, throat and fore neck almost white becoming isabelline-buff on the rest of the lower parts, the vent and surrounding parts with under tail-coverts barred white and brown.

Very young birds have the supercilia, face and whole lower plumage white, barred with blackish-brown. These bars gradually disappear and in a more advanced stage the young become replicas of the female with very pale, almost white underparts.

Nestling.—All black.

Distribution.—Throughout South and Central Europe and South-Western and Central Asia migrating in winter to Northern Africa and to India into Sind and Baluchistan ; Scully also obtained it in Gilgit.

Nidification.—The Little Crake breeds throughout South and Central Europe as well as in Western Asia, probably as far East as Persia and Turkestan. The breeding season lasts from early May to the end of June though a few continue to breed as late as the middle of July. The nest differs in no way from that of the other rails, and like them is placed in any thick vegetation around lakes, swamps or the banks of streams. The eggs number from 6 to 12, generally 7 or 8. The ground colour is a pale ochre or buff brown, sometimes with a rather greenish tint, whilst the markings consist of numerous blotches and spots of darker brown scattered fairly numerously over the whole surface. There are also a few underlying spots of neutral tint and in some eggs these are rather more numerous and make the general tone of the egg more dull and grey. The surface is smooth and generally glossless. The average of 100 eggs is 30·45 × 21·73 mm., *maxima* 30·5 × 23·0 mm., *minima* 28·0 × 19·0 mm.

Habits.—The Little Crake must be a very rare visitor to any part of India, but it is such an inveterate little skulker that it is quite

possible that it is not so rare as its very scanty records would make it out to be, so that sportsmen shooting on the borders of Baluchistan and the North-Western Frontier Provinces anywhere in the vicinity of water, should be on the look-out for it. Like all rails, it will not rise until almost trodden on and then gets up with a soft whirr of wings and flies rapidly away for two or three hundred yards when it drops suddenly into cover. In flight it rather reminds one of a quail but it has the usual little rail habits of keeping its legs hanging down until it gets well on the wing. Apparently this bird is almost entirely insectivorous in its diet and it appears to be especially fond of coleoptera and aquatic insects and in search of its diet it keeps almost exclusively to swamps and marshes, very seldom being found in dry grass or crops away from water.

Porzana pusilla pusilla

The Eastern Baillon's Crake

Rallus pusillus, Pall., Reis. Russ. Reich., iii, p. 700 (1776) (Dauria).

Porzana pusilla, Blanf. and Oates, iii, p. 165.

Vernacular Names.—*Jhilli* (Nepal).

Description.—Upper plumage rufous-brown, the feathers streaked with black, the streaks on the hind neck inconspicuous and the wing-coverts without any ; scapulars, back, rump, upper tail-coverts and inner wing-coverts curiously streaked or marked with white as if smeared with white paint ; quills brown, the first primary conspicuously edged with white ; lores next the eye and a small streak behind it rufous brown ; supercilium, sides of head and neck, breast and anterior abdomen grey sometimes tinged ashy ; posterior abdomen, vent and under tail-coverts barred brown and white.

Colours of soft parts.—Iris red in adults, red-brown in younger birds and dull blue-brown in nestlings ; bill horny-green to green, the culmen and tip darker ; legs and feet yellowish-green to dull green, claws horny-brown.

Measurements.—Total length about 200 mm. or less ; being 84 to 91 mm. ; tail 40 to 46 mm. ; tarsus 27 to 28 mm. ; culmen 14 to 16 mm.

Young birds have the underparts almost white, the sides of the neck, breast and flanks suffused with pale ruddy-brown ; the brown eye streak is broader.

Nestling.—All black, a greenish tinge to the tips of the down.

Distribution.—Ceylon, all India, Burma and the Andamans ; as far West as Afghanistan and East to the Indo-Chinese countries and all China. It occurs through the Malayan Archipelago to the Philippines.

Nidification.—Baillon's Crake breeds in Kashmir in all the larger swamps and lakes, and Osmaston. Betham and others have taken many of their nests. Osmaston found it breeding almost entirely in and round the lakes and swamps, the nests, made of grass and weeds, lined with dry grass, being well hidden amongst thick cover either of reeds or of grass and weeds. In some cases the nest is built amongst reeds actually standing in the water, the bottom of

the nest resting on debris or on some of the broken reeds. They are very difficult to find for the bird sneaks away as a rule before one has a chance of spotting her or, if seen, it is not until she has got some yards away from her home. The eggs number 5 to 8 and differ from those of the Little Crake in being much darker and more richly coloured and also in the surface of the shells being much more glossy. In the plains this Crake often breeds in rice fields as well as in swamps and lakes, whilst Butler took one nest built in a small clump of bullrushes in a bank three or four feet above the level of the water, a very unusual position for a crake's nest. The breeding season in Kashmir is from the end of April to the middle of June but many birds continue to lay up to the middle of August, though possibly some of these may be second nests. In the plains, like all other water birds, they do not set about their domestic affairs until after the rains break in June.

Habits.—Baillon's Crake is a common bird in suitable localities practically all over India and Ceylon but it is very seldom seen except when out snipe shooting or perhaps when after quail or on bits of dry cultivation between swamps. Its flight is exactly the same as that of the Spotted Crake already described, but its flights seldom last longer than 100 yards or so and once down it is extremely difficult ever to get a sight of it again. They are very fragile little birds and fall easily to very small shot at great distances but of course are quite unworthy of being shot and practically unfit to eat when they have been brought to bag. As a rule these birds are found singly, occasionally in pairs and, being resident in India, they do not congregate in small parties as most crakes do on their first arrival and prior to their departure from India. At the same time it is quite possible that a large percentage of our Indian birds do not breed in India or, if they do, they wander up from the plains into the swamps and lakes of the Himalayas for the purpose of nesting. Their diet is both vegetarian and insectivorous and they feed largely on tiny shoots and seeds of aquatic plants. One shot by myself had its stomach full of grasshoppers, these ranging in size from the smallest to others more than half an inch long. Mixed with these were a lot of tiny white roots, probably of a water plant, and one or two small land shells. Another bird seemed to have fed principally on very small black round seeds, but what these were I have no idea. They are very quick runners and moving amongst the grass from one place to another it is often very difficult to convince oneself as to which quarter their call is coming from. The call itself is distinctly crake-like, rather high pitched, it starts with a single loud 'Crake' and then after a pause another and yet another in quick succession until the last few notes seem to run into one.

Crex crex

The Corncrake or Land Rail.

Rallus crex, Linn., Syst. Nat., 10th ed., i, p. 153 (1758) (Sweden).

Crex pratensis, Blanf. & Oates, iv, p. 163.

Vernacular Names.—None recorded.

Description.—The feathers of the crown, hind neck, back and scapulars to tail with blackish centres and ashy margins, the two colours linked by chestnut brown; upper and under wing-coverts and axillaries chestnut; primaries, secondaries and primary coverts rufous-brown edged and tipped lighter; supercilium, lores, cheeks, chin, throat and breast ashy-grey, the chin and throat almost white and a darker brown line through the eye to the neck; flanks and sides of abdomen rufescent-white with rufous-brown cross bars; centre of abdomen almost white and unbarred.

In summer the supercilium, sides of the head, neck and breast are browner and less grey.

Colours of soft parts.—Iris hazel to red-brown; bill pale horny-brown, a little darker on the terminal portion of the culmen; legs and feet pale brown or fleshy-brown.

Measurements.—♂ wing 135 to 150 mm.; tail 40 to 50 mm.; tarsus 34 to 43 mm.; bill 20 to 23 mm.; ♀ wing 130 to 145 mm.; culmen 19 to 23 mm. (Witherby).

Young birds have the wing-coverts barred with white.

Nestling.—Black, the tips of the down in the upper parts dark buff.

Distribution.—Practically the whole of Europe and West and Central Asia. In winter it migrates to North Africa and a specimen was obtained by Scully at Gilgit.

Nidification.—The nidification of this bird is almost too well known to require description. It of course never breeds within our Indian area but it is still comparatively common in many parts of Great Britain. The eggs number anything from six to fourteen whilst clutches of eggs of eighteen have been recorded. The ground colour varies from a yellowish-or greenish-stone colour to light reddish whilst the spots consist of primary blotches of rather dark reddish-brown with others underlying them of neutral tint and grey.

Witherby gives the average of 100 eggs as 37·26 × 26·75 mm., *maxima* 41·6 × 25·9 and 38·3 × 29·0 mm., *minima* 34·0 × 25·0 and 34·3 × 24·1 mm.

The breeding season is principally during June but eggs are occasionally taken both in May and in July. The nests of the Land Rail are almost invariably placed in fields of grass and are often destroyed when these are cut for hay. Occasionally they will be found in nettle beds or masses of weeds alongside hedges, but such sites are exceptional.

Habits.—This rail is a migratory bird and the only really authentic instance of its occurrence within our limits is that of a specimen obtained by Scully in Gilgit. It is one of the most confirmed skulkers imaginable and even with dogs is extremely hard to put up, so that though one may hear its loud harsh crake sounding on all sides, one may hunt long and hard without successfully obtaining a sight of the birds uttering them. Its food is almost entirely insectivorous, but it occasionally eats seeds and will also eat any caterpillars, larvæ or earth-worms it may come across whilst hunting for food. Small grasshoppers form a very favourite article of diet.

Hypotænidia striata

The Blue-breasted Banded Rail

There are three well marked forms of this rail; the typical form from the Philippines and Borneo, a small dark bird with a moderate sized bill, which is *H. s. striata*; a large dark race with a large bill from the Andamans, *H. s. obscuriora* and, thirdly, a paler form first described by Horsfield from Java which is found all over India, Burma, Malay Peninsula to Java and East into South China and Formosa. The titles and first references to these birds are as follows:—

(1) Hypotænidia striata striata

The Philippine Blue-breasted Banded Rail

Rallus striatus, Linn., Syst. Nat., 12th ed., i, p. 262. (Philippines).

(2) Hypotænidia striata obscuriora

The Andaman Blue-breasted Banded Rail

Hypotænidia obscuriora, Hume, Str. Feath., ii, p. 302 (1874) (Andamans).

(3) Hypotænidia striata gularis

The Indian Blue-breasted Banded Rail

Rallus gularis.—Horsf., Trans., Lin. Soc., xiii, p. 196 (1821) (Java).

Vernacular Names.—Kana koli (Tam.); *Wadi-koli* (Tel.); *Yay-gyet* (Burm.).

Description.—Male: Crown to hind neck rufous; upper parts dark-brown marked with wavy white bars, broken into spots on the lower back and primaries, and each feather edged with olive-brown, much abraded in worn plumage; chin and throat white; sides of the head, foreneck and breast ashy-grey; abdomen flanks, under tail-coverts, axillaries and under tail-coverts dark brown barred with white.

Colours of soft parts.—Irides light brown in younger birds to Indian red in old adult breeding birds, upper and tip of lower mandible horny-brown to dark brown, lower mandible and commissure dull yellowish-red to bright red; legs and feet olive-grey, olive or fleshy-grey.

Measurements.—H. s. striata, wing 100 to 118 mm.; tail 38 to 41 mm.; tarsus 34 to 39 mm.; culmen 31 to 36 mm. *H. s. gularis*, wing 108 to 131 mm. *H. s. obscuriora*, wing 129 to 134 mm.

Females are a trifle duller, the chestnut of the head more inclined to be streaked with blackish and the abdomen paler, more whitish.

Young birds have the feathers of the back streaked with dark brown and the white bars and spots obsolete or absent; the crown and neck are rufous brown freely streaked with dark brown.

Distribution.—The Indian form is found practically throughout Ceylon, India and Burma in suitable localities where there are sufficient marshes and swamps and it extends, as already noted, to South China and Formosa. The Andaman form is restricted to

the Andamans and Nicobars whilst the Philippine bird is also found in Borneo and the Celebes.

Nidification.—This Rail commences to breed as soon as the rains are fairly set in and the various swamps and jheels which it inhabits have begun to fill up. Over the greater part of India and Burma, August and September are the principal months during which eggs are laid, but I have found them as late as the end of October and also in the last week of June. The nest is generally a well-built one, a mass of weeds and rushes and, although that part of the material at the bottom of the nest may be decayed and wet, the upper layers seem to be always warm and dry. It may measure anything from five to seven inches in diameter whilst the depth varies according to the site. If built on dry ground, it will probably be only two or three inches deep but if on wet ground or in amongst rushes and plants in the water, I have seen them as much as a foot in depth. As a rule it is built either well in the swamps where there are plenty of weeds and vegetation or amongst the reeds, grass or bushes on the edge. Occasionally, however, it is built some distance from water but always amongst thick vegetation and well hidden. A pair of these birds built every year in a dry ditch running alongside the bungalow of the Police Officer at Jalpaiguri in Bengal, laying each year five or six eggs from which one or two chicks at the outside ever reached maturity. Unless the eggs are hard set the bird is not a close sitter but sneaks quietly off the nest whilst intruders are still at some distance. The number of eggs laid varies from five to eight, but six seems to be the normal full clutch. They are decidedly handsome eggs, the ground colour varies from almost pure white with just a faint tinge of cream or yellowish-stone to a warm salmon buff. The markings consist of reddish or purplish blotches and spots scattered rather sparsely over the whole surface of the egg but rather more numerous at the larger end though they seldom tend to form either a ring or cap. Some eggs have the markings feebler and paler consisting more of freckles and small longitudinal blotches of light red plentifully scattered all over the egg. In shape the eggs are generally rather broad ovals occasionally somewhat longer and rather pointed at the smaller end. The texture is strong, smooth and close and some few eggs have quite a fair gloss. Incubation is said to take from nineteen to twenty-two days but I have no personal experience about this.

The nesting of the Andaman form differs in no way from that of the common Indian bird. It is extremely plentiful in several of the islands and Mr. B. B. Osmaston during his stay in the Andamans took a wonderful series of their eggs. These are decidedly handsomer on an average than the eggs of its Indian cousin. Many eggs are a most beautiful salmon-pink in ground colour, others of light brick-red and others again are of pinkish-buff. The markings also are rather bolder and richer in tint, whilst eggs of the profusely but feebly marked type seem to be very exceptional. 200 eggs of the Indian bird average 33·7 × 25·8 mm.; *maxima* *36·6* × 28·6 and 36·3 × *28·8* mm.; *minima 30·6* × 25·0 and 33·9 × *23·9* mm.; 150 of the Andamans eggs average 36·0 × 27·5 mm.,

maxima 39·2 × 28·7 mm., 37·0 × 29·4 mm., *minima* 32·7 × 25·0 mm.

Habits.—The Blue-breasted Banded Rail is one of the most familiar water birds over the whole of the Oriental region and there is hardly a village pond which does not contain a pair of these birds. In such places they become extremely tame and familiar and even on the larger swamps and lakes they seem to be aware that they are of no use as food and that consequently nobody cares to shoot or trap them. They are of course adepts at swimming and are quite capable of diving, but seem very seldom to resort to it. They are excellent walkers and may very often be seen, especially in the early mornings and evenings, wandering about the edges of swamps and even in the fields some distance therefrom. They progress with rather long deliberate steps, bobbing their heads and jerking their tails up as each foot advances. When undisturbed their carriage is very upright, their tail being held almost at right angles to the body, but if disturbed, they at once slink off, crouching low down amongst the grass or, if there is no cover, scuttle rapidly along for a few paces and then take to flight. Their flight is poor and laboured and they never seem to care to travel far at a time. They feed both on small water snails, insects, etc., as well as on seeds and shoots but I think their diet is mainly insectivorous. When searching for water insects or those which are found on floating vegetation, it moves about very nimbly upon the latter, constantly picking here and there as it goes. In the stomach of one bird I examined which was shot in Mymensingh on the banks of one of the big tidal rivers, I found a mass of tiny scarlet crabs, measuring barely $\frac{1}{4}''$ across the carapace. I have also found worms, beetles and grubs in their stomachs. The only notes I have heard uttered are a short jerking scream, not however very loud, and a deep low note probably uttered only by the male and quite inaudible to the human ear at a very short distance. They are pugnacious birds and I have often seen the males fighting during the breeding season, but the fights never seem to be long sustained and no damage ever appears to be the result. Their methods of courtship seem to be much the same as that of other rails. The male approaches the female with wings held low and vibrating constantly whilst the head, instead of being held upright as at ordinary times, is held comparatively near the ground and the tail very erect as usual. When within a few inches of the female, the cock draws itself up to its full height, spreads the wings still more and then crouches again, after which the performance ceases, perhaps to be gone through again in a few seconds.

They are resident birds wherever found though local movements may occur in times of excessive drought or of excessive rainfall.

(*To be continued*)

THE POTTER WASP

BY

MAJOR R. W. G. HINGSTON, I.M.S.

PART II

(Continued from p. 110 of this volume.)

EXPERIMENTS

I now pass to a series of experiments. They have been made with the usual purpose of investigating the psychology of the wasp.

I remind the reader of the architectural sequence as detailed in the last paper. It consists of four stages: First, a cell is built of clay; second, the cell is coated with gum; third, the cell is stuffed with caterpillars; fourth, the cell is closed with a lid.

Our experiments may be divided into two classes—(1) experiments relating to instinct, (2) experiments to prove intelligence. It is the old question. Is the wasp moved by instinct only, or can she view a problem intelligently; in other words, must her actions follow a strict routine, or can she alter her mode of behaviour in order to meet some particular need?

Let us see what the experiments disclose.

EXPERIMENTS RELATING TO INSTINCT

Experiment 1.—I find a nest of four cells. The fourth cell was finished two days ago. Since then no more work has been done. I cut away this last-built cell, excise it completely, and, of course, leave a deep gap in the nest. I watch to see what the potter will do. On the next day she discovers the damage, and sets about building her fifth cell in the place from where I had excised her fourth. So much for the first experiment. There is nothing very particular about it. It is a plain manifestation of instinct. For the wasp had recently finished a cell. Her next operation in the ordinary routine would be the commencement of the fifth in the series. Therefore when she builds in the gap that I had made, she is only doing in a different place what she would otherwise do elsewhere.

Experiment 2.—I wait till she has finished this fifth cell. When the lid has been secured I excise the chamber. That is, I open up the gap a second time. The wasp sets to work, and builds her sixth cell in the gap. I cut away the sixth cell, thus opening the gap for the third time. The wasp now does not seem so eager. She waits for seventeen days before rebuilding, then constructs her seventh cell so as to fill the empty gap. In all this we again see plain instinct. The wasp is following ordinary routine. But it

shows us how persistent instinct is, and how stubbornly the architect sticks to her work.

Experiment 3.—Let us proceed. A wasp is building the cell wall. While the wall is undergoing construction I cut a strip of mud out of the edge. The deficiency is filled up without much trouble. When the wasp comes with her next pellet she just rolls in into the gap. This again is mere instinct, for when I remove the strip the wasp is engaged at building, the continuation of the act of building will of itself fill up the gap.

Experiment 4.—When the wasp is building her wall I cut a V-shaped piece from the middle of the edge. The damage is greater than in the previous experiment. The wasp, on returning, seems a little perturbed. She uses her pellet to fill the V. This we might expect. It is in accordance with the course of instinct. But the point of interest was that she did not thus employ the whole of her pellet. Her ordinary behaviour is to roll her pellet; that is her way of spreading it on the wall. In this experiment she puts part of her pellet in the V, and the remainder she rolls in the usual way. Thus the one pellet fulfils two purposes. One part repairs the gap; the other part increases the height of the wall. Again I see nothing in this but instinct, or at most just a trivial deviation from the course of ordinary routine.

Experiment 5.—A cell is built. It is being stuffed with caterpillars. While the wasp is away in search for a caterpillar I cut a wedge from one side of the gate. The wasp brings her caterpillar, stuffs it in, and returns again and again with more. But she never notices the broken gate. Yet the breach is large and the damage inconveniences her. For she now cannot fill her cell completely owing to the caterpillars falling out through the breach. Nevertheless she takes no notice, nor makes any attempt at repair. Nothing is done till provisioning is finished. Then she fills up the wedge-shaped deficiency when the time comes to close the lid.

Blind instinct, we may say, is the moving impulse. The wasp is provisioning, collecting caterpillars. This is not her time for masonry, hence she cannot repair the gate. Such might be the conclusion were our experiments to cease here.

Experiment 6.—Here is more convincing testimony. Not only does it show the blindness of instinct, but the futility to which it leads.

A cell is about half-built. The mason is busy at work. During her absence I fix to the edge of her wall a tiny pellet of mud. The nodule is no bigger than a pin's head, and I place it on the edge just at the point where the mason begins to roll her clay. The wasp returns. The strange excrescence strikes her immediately. She has been accustomed to an even edge. Here is something quite out of her experience; she has never met with anything like this before. What will she do? I expect to see her grip it and throw it to the ground. But this does not happen. She becomes agitated, first thoroughly examines the nodule, then withdraws into the cell and seems disinclined to build. Clearly she is very concerned at the unexpected state of affairs. But the nodule remains; she makes no effort to cut it away. Then she does

something quite peculiar. She climbs out on one of her completed cells, tears from it a particle of gum which she smears on her half-constructed wall. Now this is very unusual behaviour. I have described how *Rhynchium* builds first her masonry, then applies the layer of gum. That is her ordinary sequence. Yet here, because of my nodule, she smears gum over a cell that is only half built. She fetches more gum, brings piece after piece, works with extraordinary energy, smearing as she never smeared before. This strange occupation keeps her busy till nightfall. By then the wall, though only half built, is thoroughly smeared and studded with gum. Her night is spent clinging to the nest. Next morning she takes up the task. The useless gum-smearing now ceases, and the work of building is resumed.

Now for the interpretation. The wasp will not ordinarily commence smearing until the cell is completely built. Yet here, because of my nodule, she begins to smear feverishly a cell that is only half-built. Is not this a fruitless mode of behaviour? What purpose can it have in view? I regard it as misguided instinct. Its meaning is as follows. The application of gum is a protective instinct, a device to keep parasites out of the cell. The wasp, when she finds the strange nodule, feels immediately on guard. To her it indicates intrusion. An enemy has been here. Her natural instinct of protection is aroused. This consists in collecting gum and spreading it on a cell. The instinct is most valuable, no doubt essential, when employed at the correct time. But here it is called forth by a strange experience introduced at an unexpected time. Hence the futility. The wasp is involved in many hours of utterly fruitless toil.

Experiment 7.—One last experiment, another display of blind instinctive force. A cell is almost built; only one or two more pellets are required. I place a fragment of camphor inside while the wasp is away collecting mud. Soon she returns. The unpleasant smell immediately distracts her. She tries to build, but the odour overpowers her, and she soon desists. She cannot work in this noxious fume. Her head goes down into the cell, with the pellet still in her jaws. The odour drives her back. She makes another effort, and soon her whole body disappears inside. But she has not the pluck to seize the camphor and cast it out of the cell. On the contrary I observe that same futile behaviour which took place in the previous experiment. She falls back on instinct, misguided instinct. Gum is torn from adjoining cells and smeared with persistent energy over the uncompleted wall. Till sunset this ineffectual toil continues; then she abandons the nest for the night.

Surely, as in the previous experiment, this spreading of gum is useless toil. It cannot remove the nauseous camphor, yet she sticks to it half the day. Such behaviour is misguided instinct *Rhynchium,* indeed, is little better than *Eumenes,* though *Eumenes* sealed camphor, egg and caterpillars all together in one cell.

These experiments explain my point. They indicate how strong is the instinctive force controlling the behaviour of the wasp. If experiment now ceased we might regard the wasp as a rigid

mechanism compelled to work in an unchanging course. But such, I feel sure, would be a wrong conclusion. Further experiment will alter our opinion. It will show that something higher than instinct has a place in the insect's mind.

Experiments to prove Intelligence

Experiment 1.—A cell is built; the layer of gum is being applied. I remove the rim all round the gate, in fact amputate the upper fourth of the cell. Now I see a surprising result. I expect the mason to continue gumming; that was her business when I cut off the rim. But no. Without apparent disconcertion she gives up gumming, goes off, fetches mud, and rebuilds the edifice to the top. This is something quite unexpected. Certainly not in the course of instinct, but behaviour outside ordinary routine. Let us reserve the explanation. We must apply more rigid tests.

Experiment 2.—I have told how I excised a completed cell in order to see if it could be restored. But on one occasion I did additional damage. For clumsily I not only excised the chamber, but also happened to break the partition that separated it from an adjoining cell. A ragged breach was left through which the young wasp could be seen inside. What will *Rhynchium* do now? Certainly I did not anticipate her action. I imagined that she would follow routine, would ignore the damage, and set about building a new cell. Such is the accustomed action. When routine behaviour is interrupted an insect recommences at the point where the routine was broken. But not so in this experiment. The wasp is aware of the damage immediately, discovers the breach, tests it, gauges it, goes off for pellets of mud, and soon makes the rent secure. Not till this is finished does she commence building a new cell.

How can she be in strict bondage to instinct? Such behaviour shows a clear appreciation of conditions and a capacity to modify her actions in accordance as such conditions require.

Experiment 3.—I put her to a further test. A cell is built. The egg is inside. The wall has been smeared with gum. I make a hole in the bottom of the pot. It is about the size of her gateway, large enough for me to push in a forceps and extract the egg. What will her behaviour be now, in face of an experience altogether new? I expect to find her completely at fault. More than likely she will take no notice, just continue the instinctive round. Again I am mistaken. The wasp arrives, quickly finds the conspicuous rent. Perhaps she is aware of the stolen egg. At any rate a careful examination follows. Her antennæ investigate the edge of the hole; at intervals she bites at it as if testing it with her jaws. She stands astride the perforation, thrusts her head into it, then walks through it into the cell. But now see what happens. She pulls from the wall a bit of gum and smears it on to the edge of the rent. She digs out another nodule which she spreads in the same way. For an hour she continues trying in vain to close a hole by smearing gum around the edge. The operation was delightful to witness, the very hopelessness of it, the futility of employing gum to close a gaping rent.

The explanation is simple. When I broke into the cell the wasp had just finished smearing gum. This was the type of work on which she was last engaged. She finds my rent, endeavours to repair it, but, being under an instinctive impulse, strives to continue the same type of work. Hence she persists in gum-smearing and tries to mend the hole with gum. For two hours I watch her at this fruitless task. By evening nothing has been effected. The wasp spends the night in a perforated cell.

So far we see nothing but blind futile instinct. But wait. Instinct may have caused her much futile labour, but something better is about to take place. Next morning she takes an early flight. At her first return she examines the chamber and again carefully investigates the breach. She departs, and, at her second visit, brings with her a pellet of mud. Entering the cell, she commences repair. Clay is moulded round the edge of the breach. Working with infinite neatness, she first fills in all notches and irregularities, and thus converts my ragged opening into an evenly rounded hole. Then she extends more mud all round in the same manner as when closing a gate. The curved surface of the cell seems to cause her some difficulty. When closing the gate she places a flat lamina, but here she has to curve the clay. Nevertheless in the end she succeeds and accurately mends the hole. The work too is done with excellent finish; it is neat, smooth and gracefully moulded into the natural rotundity of the cell. Nor is she content with just a patch of mud. For when that is applied she goes off for gum which she smears all over the patch until it is indistinguishable from the rest of the cell.

Surely this act implies intelligence. It is a display of individual resource. Nor must it be imagined that the wasp was misled, that she confused the repair of a hole with the ordinary closing of a gate. For she did the repair in quite a different way. When closing the gate she sits on the outside and from there introduces the clay. When repairing the hole she first examined it from both surfaces, and then, having made a choice, elected to work from the inside. This, to my mind, is clear ingenuity. First she attempts repair with gum. This is mere instinct, the continuation of a psychic course. The act is futile; it fails utterly. A night's rest brings new realization. Now she breaks away from the bondage of routine, attacks the difficult problem intelligently, and repairs the damage with remarkable success.

Experiment 4.—Now for an experiment while the mason is building. A cell is under construction; the wall is three-quarters built. While the wasp is absent I make a hole in the wall. It is a ragged gaping rent, large enough for the wasp to crawl through into her cell. On her return she sees it immediately. Her actions show no sign of hesitation; she seems instantly to realize the right thing to do. In her jaws is a pellet, intended, of course, for building the wall. But the mason immediately diverts it from this purpose, carries it into the interior and applies it to the edge of the rent. Then she goes off for more material, at each visit moulds it round the edge until the hole is completely closed. Satisfied with this, she resumes and finishes building the wall.

Can we claim this as intelligent behaviour? Certainly the wasp was engaged at masonry when I broke into her cell. True enough she repairs the hole. But, after all, what is this? Is she not just continuing her work as a mason, though building in a different place? I grant it. Nevertheless I think there is something more. Some spark of intelligence must be given to the action. Unforseen circumstances have arisen, circumstances which are quite foreign to her life. She recognizes them, understands them, desists from the labour on which she is employed, and straightway puts things right. However I do not press the interpretation. Let us experiment still more.

Experiment 5.—From one cell of a cluster I excise the lid. This lid had been secured sixteen days ago, since when the wasp had not attended to the cell. *Rhynchium* soon finds out what I have done. Again she shows that swift appreciation which I have described in the last experiment. In five minutes she is off, returns soon to make a re-investigation, a desire, I take it to judge with greater accuracy the nature of the repair required. This second visit lasts only a moment. At the third she brings a pellet which she moulds round the edge of the gate. Others follow, and in a few more visits a new lid is built into the cell. Later in the day she gives it a finish, and smears it all over with gum.

Experiment 6.—Here is a more convincing result. Six weeks ago a *Rhynchium* had finished a cell. A young wasp had emerged from it, and the parent had replenished it a second time. For *Rhynchium,* we may remember, is attached to her nest, garnishing it, laying in it, replenishing it more than once throughout the year. For three weeks the wasp had been engaged at this replenishing, during which time she had done no masonry except for two small pellets which some days ago she had used for the lid.

I make a hole in the bottom of this cell. It is a small perforation, only the size of a pin's head. Later in the day the wasp discovers it, goes off to the trees, gathers some gum, and plugs my small hole. Gum is sufficient for this small aperture; three or four globules do the work. I now make a larger breach, one which she cannot repair with gum. Now see what happens. For days she has done no masonry. Her last act was to mend a small hole with gum. Yet she is not in the slightest disconcerted. Off she goes, collects clay, and builds a patch into the breach.

This, to my mind, is clear intelligence. There is nothing routine about behaviour of this kind. The wasp understands the problem before her; she appreciates the relation between cause and effect, and this stamps her as a rational being.

Let us sum up the result of these experiments. We are trying to demonstrate intelligent behaviour. What is intelligence? Without entering into technical definitions, surely an intelligent action is this. An insect is confronted with some new experience; it adopts an unusual behaviour in order to meet the requirements of that experience; then it must understand the nature of the experience; it must realize that a particular cause is capable of producing a particular effect, and that is the mind of an intelligent being.

Do our experiments demonstrate intelligence? Consider a few of them.

I made a hole in a cell three-quarters built. The wasp quickly repaired the damage. This, I think, requires some intelligence. The wasp must appreciate new conditions, must halt in the progress of her work in order to make the damage good. But I do not press the point. There is no change in actual routine. The wasp was plastering and the act of mending is a continuation of the plastering. If you like, it is only a diversion, only a kind of higher instinct. The mason is placing the mud on the rent instead of on the edge of the wall.

I made the hole when she was smearing gum. She began by behaving stupidly, trying in vain to close it with gum. This was a pure instinctive impulse. The wasp was just continuing the actions on which she had been engaged. Certainly she realized the damage, yet she stuck to her psychic course. In time however this stupidity ceased. She gave up smearing gum, went off for pellets, and built clay into the breach. In this we see intelligent behaviour, a clear recognition of changed conditions, a complete alteration in routine.

I made the hole in a cell that had been built six weeks ago. Here we have a crucial test. But the result is exactly the same. The wasp has not forgotten her old structure, for she soon builds up the hole.

Surely the meaning is this. A hole is made in the architect's wall. A strange experience is laid before the wasp, an experience she has never met with before. She recognizes it, deals with it, and repairs it in a rational way. Had she done so only when employed at masonry, then, I agree, it is instinct, or, at least, little more. The wasp would be only a living machine. But the facts are different. It matters not what the wasp is doing, whether plastering, smearing or provisioning, as soon as she finds a hole she repairs it in some suitable way. If it is large she mends it with masonry, if small she plugs it with gum. The point is that she repairs it on all occasions, sometimes slowly, sometimes injudiciously, but in the end does so efficiently and makes the damage good. In order to do this she alters her behaviour and breaks away from ordinary routine. There is only one conclusion. *Rhynchium* appreciates the meaning of new difficulties and takes rational steps to overcome them.

What is the mental force that underlies the architecture of the wasp? Unquestionably instinct, that wonderful knowledge, unlearnt, untaught, an innate inherited impulse handed down along the stream of time. But not this alone. I have tried to prove that there is something more, that there is the capacity to appreciate new experiences, the power to generate new thoughts, in fact the possession of intelligence and reason.

NOTES ON SOME SHORE FISHES FROM BOMBAY

BY

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The fishes included in this paper were all obtained off Bombay by Prof. F. Hallberg in 1925. They form part of the series of Indian fishes purchased from Prof. Hallberg for the collections of the Department of Ichthyology in the Academy of Natural Sciences of Philadelphia. A series of duplicate specimens has been reserved for the Bombay Natural History Society. The species are all of the littoral shore fauna of Western India, apparently representative of the more frequent forms, though several are of special interest none are new.

EULAMIIDÆ

Scoliodon acutus (Rüppell).

Two from open sea, 177 and 198 mm. Originally in formaline mauve to brown above, below light or paler.

TORPEDINIDÆ

Narke dipterygia (Schneider).

Disk subcircular, about wide as long; snout short, greater than interorbital, slightly convex across front profile as seen from above; eyes small, about half spiracle length, about $3\frac{1}{2}$ in depressed interorbital; mouth small, protractile, width equals space to front profile; teeth broad low cusps in about 15 rows in each jaw, small size likely due to youth; internasal slightly less than mouth width. Spiracles continuous with eyes, greatly larger, ovate, edge entire. Skin smooth. Dorsal inserted behind tips of ventrals or little nearer origin of upper caudal lobe than ventral origin; tail little longer than rest of body.

Brown above, with several diffuse blackish cloudings medially. Dorsal and caudal brown, also upper surface of ventral. Under surface of body and ventral below white. Length 135 mm.

This species may be known by the deeply incised outer margin of the ventral so that the front rays form an anterior lobe. Also it differs further from *Narke japonica* (Schlegel), which has the raised rim to the spiracles.

CHIROCENTRIDÆ

Chirocentrus dorab (Forskål).

Depth 5 to $5\frac{1}{4}$; head $3\frac{3}{4}$ to 4, width $3\frac{3}{4}$ to 4. Snout $3\frac{1}{2}$ to $3\frac{2}{3}$ in head from snout tip; eye $4\frac{1}{3}$ to $4\frac{1}{2}$, $1\frac{1}{8}$ to $1\frac{1}{5}$ in snout, greater than interorbital; maxillary $1\frac{2}{3}$ to 2 in head, reaches eye centre, slender; interorbital 5 to $5\frac{1}{4}$, scarcely elevated, level; cheek and preopercle with radiating venules. Gill rakers 7 + 18, finely lanceolate, more than twice gill filaments or $1\frac{1}{4}$ in eye. Scales minute most all fallen. Abdominal myomeres 24 + 13. Dorsal rays iii, 14 to iii, 16, first branched ray $2\frac{7}{8}$ to $3\frac{1}{10}$ in total head length; Anal rays iii, 26 to iii, 30, first branched ray $2\frac{1}{2}$ to $2\frac{7}{8}$; caudal $1\frac{1}{8}$ to $1\frac{1}{6}$; least depth of caudal peduncle $2\frac{7}{8}$ to $3\frac{1}{4}$; pectoral $1\frac{3}{5}$ to 2; ventral $3\frac{3}{4}$ to $4\frac{3}{4}$.

Brown, paler to light below. Neutral brown diffuse streak from above gill opening to middle of caudal base. Head with brown tint. Fins all pale. Iris gray. Length 81 to 92 mm., three examples.

ENGRAULIDIDÆ

Engraulis dussumieri (Valenciennes).

Depth $3\frac{2}{3}$; head $3\frac{3}{4}$, width $2\frac{1}{2}$ Snout 6 in head; eye $4\frac{1}{3}$, greater than snout, equals interorbital; maxillary reaches ventral origin; interorbital $4\frac{1}{3}$ in head. Gill rakers 17 + 18. Abdominal scutes 16 + 8. Dorsal rays iii, 9, 1; Anal rays iii, 32, i, origin close behind base of last dorsal ray. Length 138 mm.

Engraulis valenciennesi (Bleeker).

Depth 3½ ; head 4⅓ to 5, width 2⅖ to 5. Snout 5½ to 5¾ in head ; eye 4⅛ to 5⅕, greater than snout and subequal with interorbital, lid not free ; maxillary reaches slightly beyond pectoral base, 3¾ to 3⅘ in combined head and body, expansion 1⅓ to 1⅖ in eye : interorbital 4 to 4⅛ in head, convex. Gill rakers 10 + 14, lanceolate, slender, 1¼ in eye. Scales caducous, thin, cycloid, mostly fallen, 38 or 39 from above gill opening to caudal base and three more on latter, 12 or 13 transversely, 19 or 20 predorsal to occiput ; 6 to 10 vertical striæ, interrupted at median axis and circuli fine ; axillary pectoral scale slightly less than half of fin. Dorsal rays iii, 9, 1, first branched ray 1⅛ to 1⅙ in head ; Anal rays iii, 41 to iii, 44, i, first branched ray 1½ ; least depth of caudal peduncle 1⅞ to 2 ; ventral 2½ to 2⅔ ; caudal forked, 3⅘ to 3⅞ in combined head and body ; pectoral 3⅞ to 4⅛.

Edge of back olivaceous brown, sides and below silvery white. Gray venulose area at shoulder moderate. Iris slate. Fins all pale or whitish, hind caudal edge gray. Length 150 to 177 mm., two examples.

Comparison with an example from Padang, Sumatra, shows it to vary as follows :—

Depth 3⅓ ; snout 5 ; eye 4 ; maxillary expansion 1⅗ in eye ; interorbital 3⅜ in head. Gill rakers 12 + 17. Scales 10 transversely ; abdominal scutes 16 + 9. When fresh in arrack largely silvery, back dull olivaceous brown. Sides of head silvery white, also iris. No silvery lateral band. Humeral venules yellowish green, with horizontal waved line. Peritoneum silvery. Dorsal and caudal pale gray to dusky, medially tinged yellowish green. Other fins pale or whitish. Length 148 mm.

Engraulis tri, Bleeker.

Depth 4⅓ to 4½ ; head 4 to 4⅖, width 2¼ to 2⅖. Snout 5 to 5⅛ in head ; eye 3⅖ to 3⅔, greater than snout, equals interorbital ; maxillary variably not quite to hind preopercle edge, usually not to gill opening, length 1 1/10 to 1⅙ in head ; interorbital 3¼ to 3⅘, very slightly convex. Gill rakers 15 + 25, finely lanceolate, twice gill filaments or equal eye. Scales very deciduous, all fallen, (pockets) 28 to 30 to caudal base and 2 or 3 more on latter, 9 transversely, 18 or 19 predorsal ; 4 or 5 vertical striæ with 10 or 11 reticulated marginally and circuli fine ; scutes 5 or 6 between pectoral and ventral. Dorsal rays iii, 12 or iii, 13, first branched ray 1⅓ to 1⅕ in head ; Anal rays iii, 15 to iii, 17, first branched ray 1⅖ to 1⅗, length of fin less than 5 in entire length of fish ; least depth of caudal peduncle 2⅙ to 2½ ; pectoral 1⅖ to 1½ ; ventral 2 to 2⅛ ; caudal 3⅞ to 4 in combined head and body.

Faded pale brownish. Iris light slate. Cluster of dusky dots on top of head posteriorly, row along dorsal base, edges of caudal peduncle and anal base. Indistinct diffuse whitish median lateral band from humeral region above to caudal base medially, widest along sides of caudal peduncle though greatest width not greater than eye. Fins all pale or whitish. Caudal greyish terminally. Length 53 to 63 mm., four examples.

Differs from the closely related *Engraulis indicus* Van Hasselt in the longer anal, which said to be 5⅔ to 6 in total according to Weber and Beaufort.

Coilia dussumieri, Valenciennes.

Depth 4⅓ to 5⅙ ; head 4⅔ to 5⅘, width 2⅙ to 2⅓. Snout 4⅖ to 5⅛ ; eye 4 1/10 to 4½, greater than snout, 1⅖ to 1½ in interorbital, without lids ; maxillary reaches nearly or quite to edge of gill opening, expansion 2 to 2⅖ in eye, length 1⅙ to 1¼ in head ; interorbital 3⅛ to 3⅓, broadly convex, cavernous. Gill rakers 20 + 23, lanceolate, slender, 1⅛ in eye. Scales rather thin, caducous, cycloid ; 65 to 70 from above gill opening to caudal base, 10 or 11 transversely, 11 or 12 to occiput ; 5 or 6 largely radiating basal striæ and rest of scale with large, open reticulations, most distinct apically ; scutes 5 or 6+6 to 8, begin behind pectoral base. Dorsal fin iii, 10 to iii, 12, with small spine before dorsal, first branched ray 1⅕ to 1¼ in head ; Anal rays iii, 98 to iii, 103, first branched ray 3⅓ to 3⅖ ; caudal 1⅖ to 1⅔, pointed ; Pectoral iv to vi, 8 to 11, filaments all free, reaching nearly or at least half way to caudal base, variably 4 to 6 even on same fish ; ventral 2⅓ to 2⅔, inserted opposite dorsal origin.

Faded largely very pale brownish, lighter below, evidently with silvery reflections in life. Fins all pale, gray on anal posteriorly and on caudal Iris

slaty. Head with some brownish dots above. Length 160 to 178 mm., five examples.

These differ a little from Weber and Beaufort's figure in that the caudal is shown as $3\frac{1}{3}$ in head.

CONGRIDÆ

Uroconger lepturus (Richardson).

Depth 22 to 24; head $7\frac{3}{4}$ to 8, width 3. Combined head and trunk $2\frac{1}{4}$ to $2\frac{2}{5}$ to end of tail; snout $3\frac{1}{2}$ to 4 in head; eye 7 to 8, 2 to $2\frac{1}{5}$ in snout, greater than interorbital in young to $1\frac{1}{3}$ with age; mouth cleft $2\frac{3}{5}$ to $2\frac{3}{4}$ in head, reaches beyond centre of eye though not quite opposite hind edge; about 10 teeth on lower face of upper jaw external or before end of included lower jaw, upper laterals biserial also lower laterals but with short inner row anteriorly each side; vomer with several large anterior teeth and median row of small ones down shaft; front nostrils large, each side of snout end, with slight cutaneous rim and hind nostril rather large horizontal slit close before eye; interorbital $6\frac{1}{5}$ to $8\frac{1}{2}$ in head, but little elevated, depressed. Gill opening $4\frac{2}{3}$ in head. Skin smooth. Close above and along upper lip 3 large horizontal slits. Dorsal begins over pectoral base, becomes higher than depth of tail posteriorly, which long, tapering and slender; anal similar; caudal about long as eye; pectoral $4\frac{1}{4}$ to $5\frac{1}{3}$.

Brown, paler below on head and trunk. Iris slate. Lips whitish. Sides of head and body dusted with brownish. Dorsal, anal and caudal neutral blackish or former brown anteriorly. Pectoral pale. Length 222 to 348 mm., two examples.

MURÆNESOCIDÆ

Murænesox cinereus (Forskål).

Depth $23\frac{3}{5}$; head $7\frac{2}{5}$, width $4\frac{1}{5}$. Snout 4 in head; eye $9\frac{3}{4}$, $2\frac{1}{2}$ in snout, greater than interorbital, center opposite last $\frac{2}{5}$ in mouth cleft, which $1\frac{1}{5}$ in head; mandibular teeth erect; interorbital II, slightly convex. Head and trunk combined $1\frac{2}{3}$ in tail. Caudal 6 in head; pectoral 3. Drab gray, little lighter below. Vertical fins posteriorly dusky to blackish. Pectoral pale. Iris slate. Length 258 mm.

TACHYSURIDÆ

Osteogeniosus militaris (Linnæus).

Depth $4\frac{4}{5}$ to $5\frac{1}{5}$; head $3\frac{3}{4}$ to $3\frac{7}{8}$, width $1\frac{1}{3}$. Snout $2\frac{7}{8}$ to 3 in head; eye $6\frac{1}{2}$ to $6\frac{2}{3}$, rather low and lateral, $2\frac{3}{5}$ to $2\frac{2}{3}$ in snout, $3\frac{4}{5}$ to $4\frac{2}{5}$ in interorbital; mouth width $2\frac{2}{5}$ in head; maxillary barbel to middle of pectoral spine; broad band of villiform teeth in each jaw, of about 7 irregular rows; on palate 2 broad semioval areas of obtuse, low teeth; nostrils large, together, posterior little larger, both near snout end laterally; interorbital $1\frac{4}{5}$ to $1\frac{7}{8}$ in head, elevated convexly; median fontanel wide, not reaching occipital buckler, which twice wide at base as long and rugose striate, bony bridge complete to dorsal. Gill rakers $2 + 7$, lanceolate, slender, $1\frac{3}{4}$ in gill filaments or 2 in eye. Skin smooth; lateral line complete and median laterally. Dorsal fin with front and hind edges of spine antrorsely serrate, rays 7, first $1\frac{1}{3}$ to $1\frac{2}{5}$ in head; adipose fin large, 2; Anal fin IV or V, 16, I, first branched ray $1\frac{7}{8}$ to 2; caudal $1\frac{1}{5}$, forked; least depth of caudal peduncle 3 to $3\frac{1}{2}$; pectoral $1\frac{1}{2}$ to $1\frac{2}{3}$; ventral $1\frac{4}{5}$ to 2.

Back and head above nearly flax flower blue, below becoming pearl blue to white. Sides of head and body with obscure gray dots. Iris pale gray. Dorsal terminally gray, whitish basally. Adipose fin whitish, with gray above. Caudal pale to whitish, with gray above and below. Anal and paired fins whitish. Barbels pale. Length 158 to 180 mm., two examples.

Tachysurus sona (Buchanan-Hamilton).

Depth 5; head $3\frac{1}{4}$ to $3\frac{2}{5}$, width $1\frac{1}{6}$ to $1\frac{1}{5}$. Snout $2\frac{7}{8}$ to 3 in head; eye 6 to $6\frac{1}{4}$, 2 to $2\frac{1}{4}$ in snout, $2\frac{2}{3}$ in interorbital; mouth width $1\frac{9}{10}$ to 2 in head; maxillary barbel reaches $\frac{3}{4}$ to $\frac{7}{8}$ in pectoral, outer mental $\frac{2}{5}$, inner mental $\frac{7}{8}$ or to pectoral origin; bands of villiform teeth in jaws of about 5 or 6 transverse irregular series; on palate 2 small closely approximated patches of villiform teeth and 2 large rounded posterior areas more separated; interorbital little elevated convexly, width $2\frac{1}{5}$ to $2\frac{1}{2}$ in head; head above and occiput striate; occipital fontanel not quite reaching base of keeled occipital buckler, basal width of

which $1\frac{1}{8}$ its length, though bony bridge complete to dorsal. Gill rakers 5 + 10, lanceolate, $1\frac{1}{4}$ in gill filaments, which $1\frac{1}{4}$ in eye. Skin smooth. Lateral line complete, midway along side. Dorsal fin I, 7, compressed spine with antrorse serræ along front and hind edges, first ray $1\frac{1}{4}$ to $1\frac{1}{3}$ in head; Anal fin IV, II, first branched ray $1\frac{9}{10}$ to 2; caudal forked, $1\frac{1}{10}$ to $1\frac{1}{6}$; least depth of caudal peduncle $3\frac{7}{8}$ to $4\frac{1}{4}$; pectoral $1\frac{1}{5}$, compressed spine with outer and inner edges with antrorse serræ, 10 along inner edge; ventral $1\frac{7}{8}$ to $2\frac{1}{8}$.

Leaden gray, little paler below. Iris gray. All fins dusky to blackish terminally. Length 108 to 120 mm., two examples.

The above agree with Day's figure of an example 192 mm. shown with the front margin of the dorsal spine antrorsely serrate. They further show the lower front serræ more as close set granules.

Tachysurus cælatus (Valenciennes).

Depth $4\frac{3}{5}$ to $4\frac{2}{3}$; head $3\frac{2}{3}$, width $1\frac{1}{4}$ to $1\frac{2}{5}$. Snout $2\frac{3}{4}$ to 3 in head, eye $4\frac{4}{5}$ to $6\frac{1}{3}$, $1\frac{4}{7}$ to $2\frac{3}{5}$ in snout, 2 to $3\frac{1}{2}$ in interorbital; mouth width $2\frac{1}{6}$ to $2\frac{4}{5}$ in head; maxillary barbel reaches $\frac{2}{5}$ to $\frac{3}{4}$ in pectoral fin, outer mental to pectoral origin or $\frac{3}{5}$ in fin and inner mental little shorter; teeth in villiform bands in jaws of about 5 or 6 irregular rows and ovate areas of similar teeth on each palatine; front nostril larger, close to snout end in profile and hind one about midway in snout, higher, without barbels; interorbital elevated convexly, 2 to $2\frac{2}{3}$ in head; sides and upper surface of head, as occipital bones, buckler and humeral process rugose striate; broad occipital fontanel narrows behind and extends to base of keeled occipital buckler, base of which $1\frac{1}{4}$ its length and bony bridge complete to dorsal. Gill rakers 6 + 8, lanceolate, slender, $1\frac{1}{8}$ in gill filaments or 2 in eye. Skin smooth; few venules on side of head and front of lateral line; lateral line complete anteriorly, in young many short waved venules. Dorsal fin I, 7, compressed spine with antrorse serræ along front and hind edges, with age most of lower serræ as granules, first ray $1\frac{1}{4}$ in head to $3\frac{2}{5}$ in combined head and body with age; Anal 13 vii, or 14, first branched ray $1\frac{3}{4}$ to $1\frac{4}{5}$ in head; adipose fin large, 2 in head; caudal I, forked; least depth of caudal peduncle $3\frac{4}{5}$ to 4; pectoral 1 to $1\frac{1}{4}$, spine with antrorse serræ along both edges, 12 to 17 on inner; ventral $1\frac{3}{5}$ to $1\frac{2}{3}$.

Back dusky brown, lower surfaces white or soiled brownish. Young with back drab gray clouded with brownish, also along lower side of trunk and tail obscure brownish dustings. Fins all pale, blackish terminally with age. Barbels dusky. Length 90 to 163 mm., two examples.

Smaller example with a large isopod crustacean 21 mm. long, attached on the belly of the fish just before the ventrals. In my examples the dorsal spine ends in a long cutaneous filament.

PLOTOSIDÆ

Plotosus anguillaris (Bloch).

Depth 7; head $4\frac{1}{2}$, width $1\frac{2}{5}$. Snout $2\frac{1}{2}$ in head; eye 7, 3 in snout, $2\frac{7}{8}$ in interorbital; mouth width $2\frac{1}{5}$ in head; teeth conic, triserial above medially to uniserial laterally, biserial below medially to uniserial laterally; maxillary barbel to eye centre, nasal barbel $\frac{2}{3}$ to eye, outer mental barbel to middle of eye and inner mental barbel to front of eye; interorbital $2\frac{3}{4}$ in head, but slightly elevated and widely depressed. Gill rakers 8 + 23, lanceolate, equal gill filaments or eye. Skin smooth; lateral line complete, median on tail. Dorsal fin I, 5, first ray $2\frac{1}{2}$ in head; second dorsal with about 82 rays; Anal fin 65?; caudal $3\frac{1}{4}$ in head; pectoral $2\frac{1}{5}$; ventral $2\frac{1}{8}$.

Brown, lighter to drab or whitish on lower surface of head and belly. Pale median lateral band from above maxillary to caudal base, another parallel from above eye along back. Fins all blackish brown, at least terminally, edges of vertical fins very narrowly whitish. Iris slate. Nasal and maxillary barbels brown, mentals whitish. Length 182 mm.

FISTULARIIDÆ

Fistularia villosa, Klunzinger.

Depth $1\frac{1}{4}$ in orbit, $15\frac{1}{3}$ in head; head $2\frac{1}{2}$ to caudal base, width about $8\frac{3}{4}$; snout $1\frac{1}{3}$, from snout tip; eye $13\frac{1}{3}$, 10 in snout; maxillary slightly longer than orbital socket, $8\frac{1}{2}$ in snout; bony interorbital $2\frac{1}{8}$ in eye. Gill rakers not

developed or as few minute papillæ. Skin largely smooth to touch ; median vertebral row of narrow keels to dorsal about 36 and about 20 between dorsal and caudal ; similar ventral row from behind ventral to vent and behind anal to caudal. Lateral line distinct, with rough keel its whole length, showing 27 spines from opposite dorsal origin to caudal base. Dorsal rays 15, fifth ray $5\frac{1}{5}$ in total head length ; Anal rays 13, fifth ray $5\frac{2}{3}$; caudal $7\frac{1}{4}$, well forked, lobes pointed ; caudal peduncle depressed, least depth equals its least width or 4 in eye ; Pectoral rays 16, length $7\frac{2}{5}$ in total head length ; ventral $1\frac{1}{2}$ in eye.

Brown, beak and under surface paler. Iris slate. Caudal and filament with deep grayish, fins otherwise all pale. Length 335 mm. to caudal tip and filament 135 mm. longer.

It appears to agree in every way with an example from Natal except that its skin is smooth.

POLYNEMIDÆ

Polydactylus sextarius (Bloch).

Six examples, 74 to 130 mm. All have 7 pectoral filaments each side except one, which has 6 on the right side.

SCOMBRIDÆ

Scomberomorus kuhlii (Cuvier).

Depth $4\frac{1}{5}$ to $4\frac{1}{2}$; head $3\frac{1}{2}$ to $3\frac{3}{5}$, width $2\frac{7}{8}$. Snout $2\frac{1}{5}$ to $2\frac{7}{8}$ in head ; eye $4\frac{1}{10}$ to $4\frac{3}{8}$, $1\frac{2}{5}$ to $1\frac{1}{2}$ in snout, $1\frac{1}{10}$ in interorbital ; maxillary reaches opposite hind pupil edge, length $1\frac{2}{3}$ to $1\frac{7}{8}$ in head ; lower jaw slightly shorter ; teeth about 28 above, 34 below ; narrow band of fine teeth on each palatine and across vomer ; interorbital $3\frac{3}{8}$ to $3\frac{3}{4}$ in head, but slightly elevated convexly. Gill rakers 2 + 9, low, small, rudimentary tubercles. Scales not evident ; lateral line superior on trunk, midway along side of tail posterior to dorsal and anal lobes. Dorsal fin XVI—iii, 15 + 7, third spine $2\frac{2}{5}$ in head, first branched ray 3 to $3\frac{1}{10}$; Anal fin v, 14 + 7, first branched ray $2\frac{4}{5}$ to $3\frac{1}{4}$; caudal $1\frac{2}{5}$, widely forked ; least depth of caudal peduncle $6\frac{1}{10}$ to $6\frac{1}{2}$; pectoral $2\frac{3}{8}$ to $2\frac{3}{4}$; ventral $3\frac{1}{8}$ to $3\frac{1}{3}$.

Back clove brown, pale drab to whitish below. Iris pale slate. Fins all pale, spinous dorsal blackish anteriorly or over first 4 membranes at least. Length 61 to 78 mm., two examples.

These evidently the young, the adult described as uniform.

TRICHIURIDÆ

Trichiurus muticus, Gray.

Depth $15\frac{1}{3}$; head $8\frac{4}{5}$, width $5\frac{3}{4}$. Combined head and trunk $3\frac{3}{8}$ in tail ; snout $2\frac{3}{4}$ in head from snout tip ; eye 6, $2\frac{1}{8}$ in snout, greater than interorbital ; maxillary reaches eye, length $2\frac{3}{4}$ in head ; interorbital 8, convex. Gill rakers II + 16, very slender, short, $3\frac{1}{2}$ in gill filaments, which $1\frac{2}{5}$ in eye. Skin smooth ; lateral line slopes down to lower third in body depth at anal origin. Dorsal begins at first fourth between hind eye edge and pectoral origin, rays 112 so last fourth of tail free of rays, greatest dorsal height $2\frac{1}{8}$ to $3\frac{1}{4}$ in head including mandible tip ; Anal spines about 90, all low, short, little distinct, first one little developed or rudimentary ; pectoral 3 in head ; ventrals as 2 approximated small scales on ventral median line of abdomen posterior to head space equal to postocular region.

Brown above, sides and below silvery white. Iris slate. Length 361 mm.

Trichiurus savala (Cuvier).

Depth $21\frac{1}{4}$; head 8, width $5\frac{3}{5}$. Combined head and trunk $3\frac{3}{4}$ in tail ; snout $2\frac{3}{5}$ in head from snout tip ; eye 7, $2\frac{1}{2}$ in snout, greater than interorbital ; maxillary reaches opposite front pupil edge, $2\frac{1}{3}$ in head ; interorbital $8\frac{1}{5}$, depressed concavely. Gill rakers 5 + 9, short, very slender, $\frac{2}{5}$ of gill filaments or 4 in eye. Skin smooth ; lateral line slopes down to lower fourth in body depth at anal origin. Dorsal begins about midway between hind eye edge and pectoral origin, 115 rays so last $\frac{2}{5}$ of tail free of rays, greatest dorsal height $2\frac{1}{2}$ in total head length ; Anal spines 67, first equals eye, others all short though distinct ; pectoral $2\frac{7}{8}$ in head ; no traces of ventrals.

Pale brown, with leaden to silvery reflections, edge of back slightly more brownish than rest of body. Iris slate. Fins whitish. Length 305 mm.

CARANGIDÆ

Caranx kalla (Valenciennes).

Eight examples, 82 to 114 mm.

Carangoides oblongus (Valenciennes).

Four examples, 38 to 55 mm. These show depth $1\frac{3}{4}$ and all are deeper than the Calicut example I reported. They also show 6 deeper gray vertical bands on the body, the vertical fins and ventrals with more or less dusky terminally, while pectoral alone entirely pale.

Apolectus niger (Bloch).

Four examples, 62 to 80 mm. For comparison one from Padang, Sumatra, 68 mm. long agrees in every way. Compared with the figure of *Apolectus stromateus* Cuvier[1] they agree in most every way except darker in colour, especially the fins. My larger examples show ventral $1\frac{1}{4}$ to $1\frac{3}{4}$ in head. Dorsal, anal and ventral blackish. Also caudal dusky gray on each lobe basally.

STROMATEIDÆ

Pampus cinereus (Bloch).

Depth $1\frac{1}{3}$ to $1\frac{1}{2}$; head 3 to $3\frac{1}{4}$, width 2. Snout $3\frac{3}{4}$ to 4 in head, protruded beyond mouth; eye $3\frac{3}{4}$ to 4, subequal with snout, $1\frac{1}{2}$ to $1\frac{3}{5}$ in interorbital; maxillary reaches front eye edge or eye center, length 2 to $2\frac{1}{3}$ in head; interorbital $2\frac{1}{8}$ to $2\frac{1}{4}$, greatly elevated convexly. Gill rakers 4 + 9, short points, about $\frac{1}{4}$ of gill filaments, which nearly equal eye. Scales extremely minute; lateral line arched, partly like dorsal profile of back, not extending beyond soft dorsal. Dorsal fin VIII, iii to v, 39, i or 40, i, short spines truncate terminally, longest ray $2\frac{2}{3}$ to $3\frac{1}{6}$ in combined head and body to caudal base; Anal V, iii to v, 33, i to 37, i, longest ray $2\frac{1}{3}$ to 3; caudal $2\frac{1}{5}$ to 3, strongly forked, lobes end in long, slender points; pectoral $2\frac{1}{6}$ to $2\frac{2}{3}$; least depth of caudal peduncle $3\frac{1}{8}$ to $3\frac{1}{2}$ in head.

Body drab brown, belly with gray tinge. Opercle with dusky tinge. Dorsal, anal and caudal with dusky tinge. Iris slate gray. Length 60 to 122 mm., 8 examples.

LEIOGNATHIDÆ

Secutor insidiator (Bloch).

Depth $2\frac{1}{10}$ to $2\frac{1}{6}$; head $3\frac{1}{5}$ to $3\frac{1}{3}$, width $2\frac{1}{8}$ to $2\frac{1}{6}$. Snout 3 to $3\frac{1}{4}$ in head from snout tip; eye 3 to $3\frac{1}{8}$, subequal with snout, greater than interorbital; maxillary reaches in vertical till below nostril, length 2 to $2\frac{1}{10}$ in head; interorbital $3\frac{1}{3}$ to $3\frac{2}{5}$, slightly convex; small antero-supraorbital spine; lower preopercle edge finely striate. Gill rakers 7 + 19, finely lanceolate, long as gill filaments or half of eye. Scales very minute, mostly fallen; lateral line nearly parallel with dorsal profile, reaches middle or little beyond in soft dorsal length. Dorsal fin VIII, 16, i, second spine $1\frac{2}{3}$ to $1\frac{7}{8}$ in total head length; Anal fin III, 14, i or 15, i, second spine 3 to $3\frac{1}{10}$; caudal I $1\frac{1}{10}$ to $1\frac{1}{8}$, forked; least depth of caudal peduncle $5\frac{2}{5}$ to $5\frac{1}{2}$; pectoral $1\frac{1}{4}$ to $1\frac{1}{2}$; ventral $2\frac{3}{5}$ to 3.

Pale brownish generally. On back above median axis of body dozen transverse dusky bars, each formed of 3 or 4 spots. Blackish streak from below eye and along maxillary sheath vertically. On trunk and tail below median axis sprinkling of dusky dots. Iris slate gray. Spinous dorsal broadly tipped black. Fins all pale, some grayish on caudal. Length 57 to 69 mm., four examples.

CHEILODIPTERIDÆ

Amia ellioti (Day).

Depth $2\frac{7}{8}$ to 3; head $2\frac{1}{5}$ to $2\frac{1}{4}$, width $2\frac{1}{4}$ to $2\frac{2}{3}$. Snout $4\frac{1}{2}$ to 5 in head from snout tip; eye $3\frac{3}{4}$ to $4\frac{1}{3}$, greater than snout or interorbital; maxillary reaches opposite eye center or hind eye edge, expansion $1\frac{1}{2}$ to $1\frac{4}{5}$ in eye, length 2 to $2\frac{1}{8}$ in head; narrow bands of minute teeth in jaws, on vomer and palatines; interorbital $4\frac{1}{4}$ to $4\frac{1}{2}$ in head, slightly convex; lower and hind preopercle edge rather weakly and irregularly denticulate, also but few weak points about angle of preopercle ridge. Gill rakers 4 + 11, uppermost as 3 rudiments,

[1] *Hist. Nat. Poiss., Atlas*, vol. 2, plate 258.

other slender, lanceolate, equal gill filaments or $1\frac{4}{5}$ in eye. Scales 23 or 24 in lateral line to caudal base and 2 or 3 more on latter, 2 above, 5 or 6 below, 3 predorsal; cheek with 2 rows, venulose, also opercles above and occiput with venules; 12 or 13 basal radiating striæ, small weak apical denticles 5 to 10 with 4 or 5 transverse series of basal elements and circuli fine. Dorsal fin VII—I, 8, i or 9, i, fourth spine $2\frac{3}{4}$ to $2\frac{4}{5}$ in total head length, third ray $1\frac{3}{5}$ to $1\frac{4}{5}$; Anal fin II, 7, i, or 8, i, second spine $3\frac{1}{2}$ to 4, third ray 2 to $2\frac{1}{5}$; caudal $1\frac{1}{2}$ to $1\frac{3}{5}$, little convex behind; least depth of caudal peduncle $2\frac{1}{2}$ to $2\frac{3}{5}$; pectoral $1\frac{4}{5}$ to $2\frac{1}{5}$; ventral $1\frac{9}{10}$ to 2.

Uniformly pale brown. Iris slate. Dark streak from below eye on cheek. Top of head with dusky dots. Black median streak on chest. Outer $\frac{2}{5}$ of spinous dorsal black. Soft dorsal with dusky border and median horizontal dusky band. Anal with blackish median longitudinal band. Caudal grayish, with whitish submarginal band and black border. Ventral dusky basally and median dusky gray area. Length 77 to 105 mm., four examples.

Amia frenata (Valenciennes).

Depth $2\frac{3}{4}$; head $2\frac{2}{5}$, width $2\frac{1}{3}$. Snout $4\frac{1}{2}$ in head from snout tip; eye $3\frac{1}{4}$, greater than snout or interorbital; maxillary reaches opposite hind pupil edge, expansion 2 in eye, length 2 in head; teeth fine, minute, narrow bands in jaws, on vomer and palatines; interorbital 5, nearly level; preopercle edge minutely denticulate, ridge entire. Gill rakers 4 + 10, slender, lanceolate, twice gill filaments or $1\frac{4}{5}$ in eye. Scales 23 (pockets) in lateral line to caudal base and 2 more on latter, 2 above, 6 below, 5 predorsal; 2 rows on cheek; 15 basal radating striæ, 78 biserial apical denticles and circuli fine. Dorsal fin VII—I, 9, i, third spine $2\frac{1}{10}$ in total head length, first ray $1\frac{3}{4}$; Anal fin II, 8, i, second spine $2\frac{4}{5}$, second ray 2; caudal $1\frac{1}{5}$, emarginate; least depth of caudal peduncle $3\frac{1}{8}$; pectoral $1\frac{1}{2}$; ventral $1\frac{3}{4}$.

Pale drab brown generally, scales on back with dark edges, under surface paler. Dusky brown line from occiput till below end of soft dorsal. Dark brown band less than pupil in width from side of snout through eye across postocular to caudal base medially and out over caudal. Middle of side of head and body sprinkled with dusky dots. Fins all whitish, terminally grayish, also upper and lower caudal edges grayish. Pectoral uniform whitish. Iris slate. Mandible dusted with brownish terminally. Length 70 mm.

ACROPOMATIDÆ

Acropoma japonicum (Günther).

Depth 3; head $2\frac{1}{4}$, width $2\frac{3}{4}$. Snout 4 in head from snout tip; eye 4, greater than interorbital; maxillary reaches opposite first third in eye, length $2\frac{2}{3}$ in head, expansion 2 in eye; teeth fine, minute, in narrow bands in jaws, on vomer and palatines, also front pair of small canines in each jaw, depressible, lower smaller (accessory canine both above and below); interorbital $5\frac{1}{2}$ in head, level; preopercle ridge and edge entire. Gill rakers 6 + 14, slender, lanceolate, greater than gill filaments or 2 in eye. Scales very caducous, about 40 (pockets) in lateral line to caudal base, 4 above, 8 below, II predorsal; 4 rows on cheek; 4 to 6 basal radiating striæ, apical denticles 40 to 44, uniserial, small circuli fine; lateral line high along back, slopes down to caudal base medially. Dorsal fin VIII—I, 10, i, third spine $2\frac{1}{2}$ in total head length, first ray $2\frac{1}{10}$; Anal fin III, 7, i, third spine $4\frac{1}{6}$, first ray $2\frac{3}{4}$; caudal $1\frac{2}{3}$, forked; least depth of caudal peduncle $3\frac{3}{4}$; pectoral $1\frac{4}{5}$; ventral $2\frac{1}{2}$; vent at last $\frac{2}{5}$ in depressed ventral.

Drab gray above, below similar. Diffuse neutral slate area from pectoral base to base of lower caudal lobe. Iris gray. Fins all pale. Soft dorsal rays basally and rudimentary caudal rays sprinkled with dusky dots. Length 105 mm.

SPARIDÆ

Sparus spinifer Forskål.

One example 110 mm. Dorsal filaments reach emargination of caudal fin.

MULLIDÆ

Upeneoides vittatus (Forskal).

One example 147 mm. Differs a little from Day's figure in that the last membrane of spinous dorsal dusky or blackish. Dorsal with apex dusky or

blackish. Soft dorsal also with apex dusky, then median longitudinal dusky band and finally imperfect basal dusky band which continues to end of last ray. Lower caudal lobe with 4 oblique dusky bands.

SCIÆNIDÆ

Otolithus ruber (Schneider).

One example 163 mm.

Johnius miles (Lacépède).

Dorsal $3\frac{1}{3}$; head 3, width $1\frac{9}{10}$. Snout $3\frac{1}{2}$ in head ; eye $4\frac{1}{6}$, $1\frac{1}{4}$ in snout, $1\frac{1}{10}$ in interorbital ; maxillary reaches opposite hind eye edge, expansion $1\frac{3}{4}$ in eye, length 2 in head ; bands of villiform teeth in jaws, above with outer row of rather wide spaced enlarged teeth, anteriorly 3 or 4 each side largest and all external to closed mandible; mandible also with outer row of enlarged well spaced teeth, though shorter than largest upper ones ; chin with 4 pits ; interorbital $3\frac{2}{3}$ in head, slightly convex ; preopercle edge denticulated. Gill rakers 6 + 14, lanceolate, equal gill filaments or half eye. Tubular scales 42 in lateral line to caudal base, each tube rather large, with short branch above and another below ; 7 scales above, 7 below, 25 predorsal ; 11 to 15 basal radiating striæ, apical denticles 32 or 33, with 5 to 7 transverse series of basal elements and circuli fine. Dorsal fin X1, 30, 1, third spine $1\frac{7}{8}$ in head, first ray $2\frac{3}{8}$; Anal fin II, 7, i, second spine $2\frac{4}{5}$, second ray $1\frac{4}{5}$; caudal $1\frac{1}{2}$, obtusely cuneate ; least depth of, caudal peduncle 4 ; pectoral $1\frac{1}{3}$; ventral $1\frac{1}{2}$, first ray ending in short filament.

Back pale olive brown, below pale to whitish. Also back sprinkled with minute dusky dots and opercle also with dusky dots. Iris slate. Inside gill opening dusky. Spinous dorsal with membranes sprinkled with blackish. Soft dorsal with white base, greater outer portion of fin sprinkled with dusky gray. Caudal grayish. Other fins whitish. Length 92 mm.

Johnius glaucus (Day).

Depth $3\frac{1}{8}$ to $3\frac{3}{4}$; head $2\frac{7}{8}$ to $3\frac{1}{2}$, width $1\frac{4}{5}$ to 2. Snout $3\frac{1}{8}$ to $3\frac{1}{2}$ in head ; eye $3\frac{1}{2}$ to $4\frac{1}{4}$, 1 to $1\frac{2}{5}$ in snout, 1 to $1\frac{1}{4}$ in interorbital ; maxillary reaches $\frac{2}{5}$ to $\frac{1}{2}$ in eye, expansion $1\frac{4}{5}$ to 2 in eye, length $2\frac{2}{5}$ to $2\frac{4}{5}$ in head ; chin with 5 pores ; interorbital $3\frac{1}{2}$ to 4, broadly convex ; preopercle edge denticulate. Gill rakers 5 or 6 + 12 or 13, lanceolate, short, half of gill filaments, which half of eye. Tubular scales 45 to 47 in lateral line to caudal base, 6 scales above, 7 to 9 below, 19 to 24 predorsal forward nearly to snout tip ; 8 basal radiating striæ, apical denticles 22 to 28 with 8 or 9 transverse series of basal elements and circuli fine ; each tube of lateral line with short branch above and below Dorsal fin XI, 27, i to 32, i, second spine $1\frac{3}{5}$ to 3 in head, third ray $2\frac{2}{5}$ to $2\frac{1}{2}$; Anal fin II, 7, i, second spine $2\frac{1}{10}$ to 3, first ray $1\frac{1}{2}$ to $1\frac{3}{4}$; caudal 1 to $1\frac{1}{8}$, cuneate ; least depth of caudal peduncle $3\frac{1}{3}$ to 4 ; pectoral $1\frac{1}{4}$ to $1\frac{1}{2}$; ventral $1\frac{1}{5}$ to $1\frac{3}{5}$, ends in short filament.

Mauve brown above, paler to whitish below. Iris slate. Inside gill opening neutral dusky. Opercle neutral brown. Spinous dorsal dusky terminally, soft dorsal and caudal grayish, other fins whitish ; sometimes vertical fins all more or less dusky to dusky gray terminally. Sometimes paired fins sprinkled with dark dots. Pectoral with gray blotch within axil close behind origin of fin. Length 70 to 114 mm., seven examples.

Johnius belangeri (Cuvier).

Depth $3\frac{2}{5}$ to $3\frac{1}{2}$; head $3\frac{1}{3}$ to $3\frac{4}{5}$, width $1\frac{4}{5}$ to 2. Snout $3\frac{1}{4}$ to $3\frac{1}{2}$ in head ; eye $3\frac{4}{5}$ to $4\frac{1}{8}$, $1\frac{1}{4}$ to $1\frac{1}{2}$ in snout, equals interorbital ; maxillary reaches opposite eye centre, expansion $2\frac{1}{5}$ in eye, length 3 to $3\frac{1}{10}$ in head ; outer row of upper teeth slightly enlarged, lower uniform ; chin with 5 pores ; interorbital $3\frac{4}{5}$ to $4\frac{1}{8}$ in head, broadly convex ; preopercle edge flexibly serrate. Gill rakers 4 + 9, short, lanceolate, half of gill filaments, which $2\frac{2}{5}$ in eye. Tubular scales 43 to 47 in lateral line to caudal base, 6 or 7 scales above, 8 or 9 below, 23 or 24 predorsal ; 7 to 10 basal radiating striæ, apical denticles 31 to 37 with 2 or 3 transverse series of basal elements and circuli fine. Dorsal fin IX or X, 29, i or 30, i, third spine $1\frac{3}{4}$ to 2 in head, first ray $2\frac{3}{5}$ to $2\frac{2}{3}$; Anal fin II, 8, i or 9, i, second spine $2\frac{1}{8}$ to $2\frac{1}{4}$, second ray $1\frac{1}{2}$ to $1\frac{3}{5}$; caudal I, cuneate, ends in median point ; least depth of caudal peduncle $3\frac{1}{5}$ to $3\frac{1}{4}$; pectoral $1\frac{1}{5}$ to $1\frac{1}{3}$; ventral $1\frac{1}{8}$ to $1\frac{1}{5}$, first ray ends in filament.

Brown above, below whitish. Spinous dorsal, anal and ventral more or less blackish terminally, other vertical fins dusky terminally. Pectoral pale brown. Iris slate. Length 100 to 114 mm., two examples.

Sciæna russellii (Cuvier).

Depth $3\frac{1}{4}$ to $3\frac{1}{3}$; head 3 to $3\frac{1}{3}$, width $2\frac{1}{3}$ to $2\frac{1}{5}$. Snout $3\frac{2}{3}$ to $3\frac{3}{4}$; eye $3\frac{1}{2}$ to 4, subequal with snout, slightly greater than interorbital; maxillary reaches $\frac{3}{4}$ to $\frac{2}{3}$ in eye, expansion $2\frac{2}{3}$ to $2\frac{3}{4}$ in eye, length $2\frac{3}{4}$ to $2\frac{4}{5}$ in head; mandibular barbel $1\frac{3}{5}$ in eye, 2 pores each side; bands of minute villiform teeth in each jaw, palate edentulous; interorbital $4\frac{2}{3}$ to $4\frac{1}{2}$ in head, slightly convex; preopercle edge denticulate. Gill rakers 6 + 10, low, short points, $1\frac{1}{3}$ in gill filaments which $2\frac{1}{4}$ in eye. Tubular scales 45 in lateral line to caudal base, 7 above, 8 below, 28 predorsal; anteriorly in lateral line each tube with 2 short branches; basal radiating striæ II, apical denticles 25 or 26 with 7 or 8 transverse series of basal elements and circuli fine. Dorsal fin XI, 26, i or 27, i, third spine 2 $\frac{1}{10}$ to $2\frac{1}{3}$ in head, first ray $2\frac{1}{4}$ to $2\frac{2}{3}$; Anal fin II, 7, i, second spine $2\frac{1}{3}$ to $2\frac{2}{3}$, first ray $1\frac{3}{4}$ to $1\frac{7}{8}$; caudal $1\frac{1}{10}$ to $1\frac{1}{8}$, cuneate; least depth of caudal peduncle 3 to $3\frac{1}{4}$; pectoral $1\frac{1}{2}$ to $1\frac{3}{5}$; ventral $1\frac{2}{5}$ to $1\frac{1}{2}$.

Light brown generally, little paler below, back and head above dusted with dusky brown. Opercle largely dusky. Iris slate. Barbels pale or whitish. Spinous dorsal largely blackish over upper portions. Soft vertical fins with grayish on outer portions. Paired fins whitish.

EPHIPPIDÆ.

Drepane punctata (Gmelin).

Three examples, 68 to 70 mm.

GOBIIDÆ

Trypauchen vagina (Schneider).

Depth $7\frac{4}{5}$ to $8\frac{7}{8}$; head $5\frac{1}{2}$ to $5\frac{1}{2}$, width $2\frac{1}{6}$ to $2\frac{1}{4}$. Snout 4 to $4\frac{1}{6}$ in head from snout tip; eye $11\frac{1}{2}$ to 12, $2\frac{3}{4}$ to $3\frac{1}{4}$ in snout, $1\frac{3}{4}$ to 2 in interorbital; maxillary reaches opposite eye, 3 to $3\frac{1}{3}$ in head; band of fine teeth in each jaw and outer row of enlarged ones, lower larger and as pair of anterior canines and several laterals; interorbital $6\frac{1}{4}$ to 7, convex. Gill rakers 1 + 5, short, low, rudimentary papillæ. Scales 70 to 75 between gill opening in median lateral series to caudal base, 15 to 17 transversely at anal origin; predorsal largely scaleless; 12 or 13 basal radiating striæ, circuli moderately fine. Dorsal fin VI, 48 to 50, height $3\frac{3}{4}$ to 4 in total head length; Anal fin 48, height $3\frac{3}{4}$ to $4\frac{2}{3}$; least depth of caudal peduncle 3 to $3\frac{1}{3}$; pectoral $2\frac{7}{8}$ to $3\frac{3}{4}$; ventral 3 to $3\frac{1}{3}$.

Light gray brown generally. Iris grayish. Fins all pale brown. Length 113 to 137 mm., three examples.

PLEURONECTIDÆ

Pseudorhombus russellii, Gray.

One example, 110 mm.

SOLEIDÆ

Paraplagusia bilineata (Bloch).

Depth 4; head 4, width $4\frac{3}{5}$. Snout to upper eye $2\frac{2}{5}$ in head; upper eye $10\frac{1}{4}$, advanced $\frac{3}{4}$ its diameter from lower eye, $4\frac{3}{4}$ in snout, equals interorbital; mouth cleft $4\frac{1}{2}$ in head, little curved, rictus reaching opposite hind eye edge; left (colored side) lips each with fringe of fleshy tentacles, lower better developed and right lips entire; rather broad band of villiform teeth on right side of each jaw, left side edentulous. No gill rakers. Scales 76 in median lateral line from opposite end of hind edge of gill opening to caudal base, 14 above median lateral line to upper and 22 below to lower body edge; no lateral line on right side; left scales with 22 to 25 basal radiating striæ, apical denticles 21 to 23, large and 4 or 5 transverse series basally, circuli fine; right scales with 27 to 29 radiating striæ, 19 to 21 large apical denticles and circuli fine; small scales crowded along body edges and over caudal basally. Dorsal fin 98, height $3\frac{7}{8}$ in head; Anal fin 73, height 4; caudal $2\frac{1}{4}$, pointed.

Left side brown clouded little with darker. Fins all deeper brownish. Right side pale. Length 130 mm.

Cynoglossus macrolepidotus (Bleeker).

Two examples 144 to 167 mm. Scales 52 to 58 in median lateral line counted from opposite hind edge of gill opening.

BREGMACEROTIDÆ

Bregmaceros atripinnis (Tickell).

Depth $6\frac{1}{5}$ to $6\frac{1}{4}$; head $5\frac{4}{5}$ to 6, width $1\frac{3}{4}$ to $1\frac{4}{5}$. Snout 4 in head from snout tip; eye 4, equals snout, $1\frac{1}{3}$ to $1\frac{2}{3}$ in interorbital; maxillary reaches $\frac{2}{3}$ to $\frac{3}{4}$ in eye, length $2\frac{1}{5}$ to $2\frac{1}{4}$ in head; narrow bands of fine teeth in jaws and large examples with narrow bands across vomer but none on palatines; interorbital $2\frac{7}{8}$ to 3, convex. No gill rakers. Scales 63 to 64 in median lateral series from above gill opening to caudal base, 16 or 17 transversely; no lateral line; scales with moderate circuli, all ending marginally basally and narrow interspace between each line studded with minute rugosities. Dorsal fin 1—56 to 60, dorsal spine $3\frac{3}{4}$ to $4\frac{1}{6}$ in combined head and body, height of rayed dorsal $4\frac{2}{5}$ to $4\frac{3}{5}$; Anal fin 55 to 58, height $4\frac{2}{5}$ to $4\frac{1}{2}$; caudal $1\frac{3}{5}$ to $1\frac{3}{4}$ in head; least depth of caudal peduncle $3\frac{3}{4}$ to 4; pectoral $1\frac{1}{6}$ to $1\frac{1}{4}$.

Brown, back with each scale pocket bordered with dusky dots so whole back above darker. Under surface of body whitish. Head grayish. Iris slate gray. Front dorsal lobe blackish, rest of fin with dusky, at least terminally. Anal whitish, terminally lobe blackish and fin grayish posteriorly. Cauda dusky gray. Pectoral blackish. Ventral white. Length 73 to 93 mm., four examples.

TETRODONTIDÆ

Sphœroides lunaris (Schneider).

Depth (retracted) $2\frac{7}{8}$; head $2\frac{3}{5}$, width $1\frac{3}{5}$. Snout $2\frac{1}{5}$ in head; eye $3\frac{1}{4}$, $1\frac{1}{2}$ in snout, $1\frac{3}{4}$ in interorbital; mouth width $3\frac{3}{8}$ in head; interorbital $2\frac{3}{4}$, broadly convex; gill opening $3\frac{2}{5}$. Top of head from behind nostrils and predorsal finely spinescent, also inflatable abdomen below, body otherwise smooth; slight lateral fold along lower side of tail; lateral line high at first, drops midway on tail behind dorsal and anal lobes. Dorsal fin II, II, first branched ray 2 in head; Anal fin II, 10, first branched ray 2; caudal $1\frac{2}{5}$, lunate; least depth of caudal peduncle $5\frac{1}{5}$; pectoral $1\frac{7}{8}$.

Drab above, grayish to whitish below. Iris slaty. Fins pale brownish, pectoral and anal whitish. Length 77 mm.

Sphœroides viridipunctatus (Day).

Depth (retracted) $2\frac{1}{2}$ to $2\frac{3}{4}$; head $2\frac{3}{4}$ to $2\frac{4}{5}$, width $1\frac{1}{4}$ to $1\frac{2}{5}$. Snout $2\frac{1}{10}$ to $2\frac{1}{4}$ in head; eye 4 to $5\frac{1}{5}$, $1\frac{7}{8}$ to $2\frac{7}{8}$ in snout, $2\frac{1}{3}$ to 3 in interorbital; mouth width $3\frac{7}{8}$ to $4\frac{1}{4}$ in head; nasal aperture large, with short cutaneous rim; interorbital $1\frac{9}{10}$ to $2\frac{1}{10}$, broadly convex, depressed medially. Gill opening $3\frac{1}{3}$ to 4 in head. Occiput from behind interorbital space about half-way in predorsal with fine spinules; abdomen up till level with lower pectoral base and backi about eye diameter to snout length before vent with fine spines, body otherwise naked; lateral line arched high to predorsal, falls median on side of cauda peduncle posteriorly. Dorsal fin iii, 7, i, or iii, 8, i, first branched ray $1\frac{7}{8}$ to 2 in head; Anal fin ii. 6, i or i, 7, ii, first branched ray $2\frac{1}{5}$ to $2\frac{1}{2}$; caudal $1\frac{1}{4}$ to $1\frac{2}{5}$, truncate; least depth of caudal peduncle $2\frac{4}{5}$ to 3; pectoral 2 to $2\frac{1}{8}$.

Back gray brown, lower sides and under surface whitish. Sides with dark reticulations leaving many rather large pale longitudinal whitish spots. Fins all pale. Caudal blackish terminally. Iris slate gray. Length 64 to 102 mm., three examples.

Apparently the young, these examples differ in that Day describes the nostrils as 2 solid tentacles. Likewise they do not show 4 black spots under the throat or the anal tipped with black. There is however the median transverse pale band across the posterior interorbital. Some also show a dark blotch before the dorsal.

Leiodon cutcutia (Buchanan-Hamilton).

Depth (retracted) 3; head $2\frac{1}{2}$, width $1\frac{1}{4}$. Snout $2\frac{3}{4}$ in head; eye $4\frac{3}{4}$, $1\frac{3}{4}$ in snout, $2\frac{1}{10}$ in interorbital; mouth width $4\frac{1}{2}$ in head; nasal tube bilobate: interorbital $2\frac{1}{4}$, broadly convex; gill opening $4\frac{1}{2}$. Skin entirely smooth,

Dorsal fin I, 15, sixth branched ray $2\frac{1}{6}$ in head ; Anal fin I, 12, sixth branched ray $2\frac{1}{10}$; caudal $1\frac{2}{5}$, truncate ; least depth of caudal peduncle $2\frac{1}{2}$; pectoral 2.

Gray brown above, clouded darker. Side medially with more or less whitish, marked with many rather large rounded blackish brown spots. Belly before vent blackish. Faint light band across interorbital. Iris slate gray. Fins all pale brownish and caudal blackish terminally. Length 103 mm.

ANTENNARIIDÆ

Antennarius hispidus (Schneider).

Depth $1\frac{3}{4}$ to $1\frac{4}{5}$; head $1\frac{1}{2}$, width $2\frac{1}{4}$ to $2\frac{3}{4}$. Snout $5\frac{1}{2}$ to $5\frac{4}{5}$ in head from snout tip ; eye 10 to $12\frac{1}{2}$, 2 in snout, $2\frac{1}{8}$ to $2\frac{1}{4}$ in interorbital ; maxillary $2\frac{7}{8}$ to $3\frac{1}{4}$ in head ; mouth width $2\frac{3}{4}$ to $2\frac{4}{5}$; interorbital $4\frac{1}{2}$ to $4\frac{2}{3}$, convex. Gill opening equals eye. Skin covered with wide set villose points. Dorsal fin I–I–I–11 or 12, first spine depressed equals length of second spine, with fleshy terminal bulb ; Anal fin 7 ; pectoral 9 to 11 ; ventral 5.

Drab brown, slightly paler below. Back and sides above with variable dusky to blackish brown lines or bands, more or less vertical and others radiating from eye, also some breaking in places to spots and bars. Dorsal, anal and caudal more or less spotted with blackish. Iris pale slate. Ventral with several dusky spots. Length 52 to 55 mm., three examples.

THE MOGHUL EMPERORS OF INDIA AS NATURALISTS AND SPORTSMEN

BY

SALIM A. ALI

PART III

(*Continued from page 63 of this volume.*)

REPTILES

THE CROCODILE

Babur [1] mentions that " One of the aquatic animals is the *Sherābi* (i. e. ' Water lion '). It dwells in standing waters (i.e. lagoons left on the banks of the great rivers after an inundation, etc.) and resembles the *Gilas* (lizard). They say it carries off men and even buffaloes.

" Another is the *Sipsar*.[2] This too is like the crocodile. It inhabits all the rivers of Hindustan. One was caught and brought to me. It may be four or five *gaz* (10 or 12½ feet) in length and some are even larger. Its snout is upwards of half a *gaz* long. Both in its upper and lower jaw it has several very small ranges of teeth. It comes out and sleeps on the edge of the water."

The reference no doubt is to the two species of crocodiles found in India, viz. the Marsh Crocodile (*Crocodilus palustris*) and the Estuary Crocodile (*C. porosus*), though it is difficult to ascribe the species with any certainty. The former is the common crocodile of our inland waters and attains an average length of 12 ft. while the latter, in India, is practically confined to the East Coast and is reputed to grow up to 33 ft.

Babur continues: " The Gharial is a large fish. Many of the army saw it in the River Saru (Gogra). It carries off men. During the time we remained on the River Saru, one or two slave boys were siezed by it and carried down. Between Ghazipur and Benares it also carried off 2, 3 or 4 of our men. In that vicinity I saw a gharial from a distance, but I could not get a distinct view of it."

There is a general belief that the Gharial (*Gavialis gangeticus*) lives exclusively on small fish, and in fact the structure of its mouth apparently is not such as to admit of its negotiating larger prey. The discovery however, of brass rings, bangles and other human adornments in its stomach from time to time, indicates that it can thrive comfortably enough on human food, and Babur's records of its appropriating several of his men may be quite in

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[1] *Babur*, vol. ii, p. 223.

[2] As King suggests, this may be a corruption of *Siyah-sar* (" Black head ") the Persian for Crocodile.

order, though it is equally possible that these finds may be attributed to the reptile's habits of feeding on corpses. An instance of human ornaments being found in a gharial's stomach along with the entire hind quarters of a donkey is recorded on page 703, vol. xxx of the Society's Journal. The slender character of the gharial's snout and its comparatively fine teeth seem little adapted to the pulling down and overpowering of larger animals such as might easily fall a prey to the mugger.

The Jesuit Fr. Monserrate writing during Akbar's reign of the Sutlej states: "This river contains crocodiles. They are called *cissares*, that is 'three headed'. They have six feet on which they crawl, and they swallow unawares from below when they are swimming in the water. They sieze by the foot and drag down under water oxen, buffaloes and sheep and other animals whilst drinking at the side of the river."

The name *cissares* which the worthy Father interprets as "three headed" is I think obviously a corruption of *Sipsar* or *Siah-sar*, the Persian for crocodile and has nothing whatsoever to do with "three". The description of this amazing six-legged monster leaves one wondering if Monserrate's accounts of other things and his "facts" are equally fanciful. As this writer is frequently accepted as an authority and a "source" by historians, one can only hope, in fairness to the times, that on other matters not so simple to verify he is slightly more reliable.

There is only one solitary record I have been able to discover of the crocodile being hunted by the Moghul Emperors. Jehangir[1] chronicles from the city of Dhar as follows:—"On Tuesday the 7th, I shot a crocodile in the tank of Dhar. Though only the top of his snout was visible, and the rest of his body was hidden under water, I fired at a guess and hit him in his lungs and killed him with a single shot. A crocodile is of the lizard (?) species and exists in most of the rivers of Hindustan, and grows very large. This was not so very big. A crocodile has been seen by me 8 *gaz* (20 feet) long and 1 *gaz* (2½ feet) in breadth."

Snakes

Abul Fazl writes that in the Sarkar of Kashmir "Snakes, scorpions and other venomous reptiles are not found in the cities. There is a mountain called Mahadeva, and in any spot whence its summit can be seen, no snake exists."

One day while the Emperor Akbar was hunting in the forests of Narwar (now in Bhopal State), his historian narrates that "His eye fell upon a serpent which was nearly 7 Akbar Shahi yards in length, and which had consumed several cheetal, which are a kind of deer, and was about to destroy more. His Majesty ordered the noxious animal to be destroyed, so that it received retribution for its actions."

The Akbar Shahi *gaz* according to Jarrett[2] was 41 fingers long. The maximum length attained by the Indian species is about 20 feet.

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[1] *Jeh.*, vol. i, p. 408.

[2] *Ain.*, vol. ii, p. 61.

Jehangir relates that one day while hunting in the neighbourhood of Aligarh he came upon a snake the length of which was 2½ yards and its girth equal to three cubits (*dast*) "He had swallowed half a hare," he notes "and was in the act of swallowing the other half. When the huntsman picked him up and brought him to me the hare fell out of its mouth. I ordered them to put it into its mouth again, but they could not do it however much they exerted themselves; but by using great violence the corner of its mouth was torn to pieces. After this I ordered them to open its belly. Thereupon another entire hare came out. They call this kind of snake *Chital* in Hindustan, and it grows so large that it swallows a *kotah-pacha* (Hog deer) entire, but it is not poisonous and does not bite."

The snake referred to is again manifestly our Indian Python (*Python molurus*).

Jehangir writes that on occasion one (*circa* A.D. 1624) while hunting, it was reported to him that a snake with a black hood (*kafcha*) had swallowed another hooded snake and gone into a hole. He ordered that it should be dug up and brought to him. "Without exaggeration," he continues, "I had never seen a snake of this size (length ?) When they opened its belly the hood of the snake it had swallowed came out whole. Although this snake was of another kind, in length and girth little difference was visible."

It is possible that the former may have been an example of the King Cobra (*Naia hannah*). Col. Wall[1] states that the staple diet of this species is snakes. He has records of its practising cannibalism and also of devouring several poisonous species including the Cobra and Banded Krait. It often swallows snakes of its own size.

According to Niccolao Manucci, popularly known as the "Pepys of Moghul India," poisonous snakes were employed at the court of the Emperor Shah Jehan in an ingenious though somewhat gruesome manner for the suppression of official corruption and *zulum*. He writes,[2] "He (the Emperor) kept his eye on the officials, punishing them rigorously when they fell short of their duty. This was the reason he kept at his court an official with several baskets full of poisonous snakes. He would order that in his presence they should be made to bite an official who had failed to administer justice leaving the culprit lying in his presence till the breath left him." Manucci had an opportunity of witnessing the execution thus of a *kotwal* or magistrate who had been found guilty of taking bribes and not acting uprightly in the discharge of his duties. "An order was given," he writes, "that he should be bitten in one hand in the Emperor's presence by a Cobra capello, the most poisonous snake on earth. The official in charge of the snakes was asked how long the man could live. The official replied that he could not live more than an hour. The king remained seated till the *kotwal* expired. He then ordered that the body should lie two days in front of his court house. . . ."

An extraordinary occurrence is narrated by the same writer, which if it has any bearing on actual facts, is difficult to interpret or ex-

[1] *Journal, B. N. H. S.*, vol. xxx, p. 192.
[2] *Storio do Mogor*, vol. i, p. 197.

plain. It would appear to be something in the nature of a snake migration and I quote it *in extenso* for what it is worth.

Manucci[1] writes: "During the time that Prince Shah Shuja (one of Shah Jehan's sons) governed the kingdom of Bengalla (Bengal) where he held his principal court in the city of Rajmahal, there happened, a few years before the rebellion in the Moghul kingdom, an extraordinary case about which he (the prince) wrote to king Shah Jehan. At eight o' clock in the day there appeared near the said city, in a plain a league and a half broad, a great number of cobra snakes large and small. They covered the field and moved from west to east until four o'clock in the afternoon; they looked like ripples in the ocean. In the greatest fright the inhabitants of the village climbed upon the tops of their houses and upon trees. They beheld moving in the midst of the said cobras one of great size which carried on its head another smaller one entirely white. They pursued their way without harming any one, many remaining behind in the suburbs of the city and in the villages and through losing their companions they died. Hearing of this event, Shah Jehan asked his astrologers what it meant. They replied that the wickedness of the empire was taking its departure and that he would survive for many prosperous years. The prince Shah Shuja also consulted his astrologers and they told him that before much time had passed there would arise a rebellion in the empire and that he would become emperor. The little cobra carried upon the head of the large one was, they said, the king of the cobras who had come to the end of his reign and was thus compelled to leave his abode."

Which shows that then as now, there were two sides to every question!

BATRACHIANS

Frogs

Babur writes: "The frogs of Hindustan are worthy of notice. Though of the same species as our own, yet they will run 6 or 7 *gaz* on the face of the water."

Dr. Annandale in his paper "The Animal Life of the Ganges" which appeared in vol. xxix, No. 3 of the Society's Journal, says, "Babur was the first to describe a peculiar habit of the commonest of our North Indian frogs (*Rana cyanophlyctis*) which skips lightly along the surface of the water when disturbed."

Abul Fazl says, "Frogs also may be trained to catch sparrows. This looks very funny.' One of the favourite amusements of the Emperor Akbar was to watch these trained frogs in action.

Such propensity in the frog may sound incredible but recent observations confirm that our Bull Frog (*Rana tigrina*), is capable of the performance even without a special course of instruction. E. H. Aitken[2] once found an adult sparrow inside one of these creatures, which appears when favoured by opportunity, to devour birds. The same observer records that on three occasions he has known a Bull Frog try to swallow a chicken at least a week old,

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[1] *Storio do Mogor*, vol. i, p. 288.

[2] *J.B.N.H.S.*, vol. ix, p. 500.

while J. A. Betham [1] has actually seen a Bull Frog swallowing a chicken, and on one occasion took from the jaws of this batrachian a Pitta (*Pitta brachyura*).

FISHES

On the subject of the Fishes of Hindustan, Babur [2] remarks follows: "Their flesh is delicate and they have few small bones. They are surprisingly active. On one occasion a net was laid in the river from side to side. Each side of the net was then raised a *gaz* (2½ ft.) above the water, yet many of the fish leaped one after the other a full *gaz* over the net and escaped. There are besides in many rivers of Hindustan small fishes which if they hear a harsh sound or the treading of a foot instantly leap a *gaz* or a *gaz* and a half out of the water."

I have had occasion to witness fish with this last mentioned peculiarity taken on the River Phuleli, a tributary of the Indus near Hyderabad. A British soldier was paddling along in a dug-out and producing a grating sound in some unknown manner, whereupon the fish leaped out and were promptly held by the man in his regulation helmet! The performance was amusing to watch.

The identity of a fish described by Babur in the following terms is a mystery. Sir Lucas King has made no comment on it, and it is surprising that such a singular animal, *if* it exists, should not be generally known. I can find no reference to anything like it in Dr. Annandale's paper either. "One fish in the *Kakeh*. On a line with its two ears issue two bones, three fingers-breadth in length. When caught it shakes these two bones which return a singular sound, whence they have given this fish its name of *Kakeh*."

Abul Fazl[3] mentions that fishing was much pursued in the Sarkar of Tattah (Sind). "There is" he writes, "a kind of fish called *Palwah* which comes up into the Indus from the sea, unrivalled for its fine and exquisite flavour."

This species, which regularly ascends the Indus in February and March in enormous swarms for the purpose of spawning, and highly prized as an article for the table, is *Clupea ilisha*, a sea-fish of the same genus as the Herring and known in Bengal as the Hilsa.

Jehangir was partial to the sport of fishing and his "bags" are recorded in his *Memoirs* from time to time. On one occasion he relates catching (netting) 766 fish which were distributed in his presence among his amirs and servants.

While in Kashmir, he paid a visit to Virnag, the source of the River Jhelum, and records that on the return journey he passed by a spring called Andha Nag (i. e. Blind fountain). "It is well known," he writes, "that the fish in this fountain are blind. I delayed a while near the spring and threw in a net and caught 12 of the fish. Of these 3 were blind and 9 had eyes. Evidently the water of the spring has the effect of making them blind. Certainly this is not devoid of interest."

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[1] *J.B.N.H.S.*, vol. x, p. 695. [2] *Babur*, vol. ii, p. 224.
[3] *Ain*, vol. iii, p. 338

Further, Jehangir[1] mentions: "I have a great liking for fish, and all kinds of good fish are brought for me. The best fish in Hindustan is the *Rohu* and after that the *Barin*. Both have scales and in appearance and shape are like each other. Everyone cannot at once distinguish between them. The difference in their flesh also is very small but the connoiseur discovers that the flesh of the *Rohu* is rather more agreeable of the two."

The *Rohu* is *Labeo calbasu* and the other possibly the Indian Trout (*Barilius bola.*)

Silk worms

Among other things found in the district of Kumaon, Abul Fazl mentions a profusion of silk worms, and at a later date Jehangir observes[2] that in Kashmir "there are no *Shah-tūt* (a kind of large mulberry) but there are *Tūt* (mulberries) everywhere. From the foot of every mulberry tree a vine creeper grows up. In fact the mulberries of Kashmir are not fit to eat, with the exception of some trees grown in gardens, but the leaves are used to feed the silk-worm. They bring the silk-worms' eggs from Gilgit and Tibet."

Sericulture in India is an industry of great antiquity. Marco Polo mentions it as flourishing in Turkestan and China in the thirteenth century and both these countries exported silk in large quantities.

Gnats, Fleas, Lice, etc.

According to Abdul Fazl, all these undesirables were to be found in plenty in the Sarkar of Kashmir.

"Black Bee" (*Xylocopa amethystina*)

After a description of the lotus and kamudini flowers, Jehangir goes on to this insect regarding which he observes as follows[3] "The black bee which the people of India call 'Bhaunra' always sits on these flowers, and goes inside them to drink the juice that is in both of them. It often happens that the flower closes and the bee remains in it the whole night. In the same manner it remains in the kamudini flower. When the flower opens, it comes out and flies away. As the black bee is a constant attendant on these flowers, the poets of India look on it as a lover of the flower, like the nightingale, and have put into verse sublime descriptions of it."

This more or less finishes the specific references made to the animals of India either by the Moghul Emperors themselves or by the better known contemporary travellers and chroniclers. Besides these accounts, miscellaneous notes were found sprinkled through the various works consulted, which are set forth below as they make interesting reading, but without any effort at arrangement, chronological or otherwise.

Hospitals for Birds and Animals

Pietro della Valle who visited India in the reign of the Emperor Jehangir describes[4] one of these *pinjrapoles* at Cambay thus:— "The house of this hospital is small, a little room sufficing for

[1] *Jeh.*, vol. ii, p. 292, *et seq.* [2] *Jeh.*, vol. ii, p. 146. [3] *Jeh.*, vol. i, p. 43.
[4] Beni Prasad, *History of Jehangir*, p. 290.

many birds of all sorts which need tendence, as cocks, hens, pigeons, peacocks, ducks and small birds, which during their being lame, or sick or mateless are kept here, but being recovered and in good plight, if they be wild are let go at liberty ; if domestic, they are given to some pious person who keeps them in his house. The most curious thing I saw in this place, were certain little mice, who being found orphans without sire or dame to tend them, were put into the hospital, and a venerable old man with a white beard, keeping them in a box amongst cotton, very diligently tended them with his spectacles on his nose, giving them milk to eat with a bird's feather, because they were so little that as yet they could eat nothing else ; and as he told us, he intended when they were grown up, to let them go free whither they pleased."

Mons. de Thevenot writing in the time of Aurangzebe of the city of Ahmedabad, states : " In this town there is an hospital for Birds. The gentiles lodge therein all the sick birds they find and feed them as long as they live if they be indisposed. Four-footed beasts have theirs also : I saw in it several oxen, camels, horses and other wounded beasts who were looked after and well fed, and which these idolators buy from Christians and Moors that they may deliver them (as they say) from the cruelty of infidels, and there they continue if they be incurable, but if they recover, they sell them to the gentiles and none else."

Decoying Game Birds by Sound

Jehangir describes a method of capturing some species of game bird (Sandgrouse?) as follows :—" While I remained in the precincts of Dehly, at the period to which I shall now return, they described to me a species of feathered game, with tails of a particular description, and the flesh of which was of a flavour in the highest degree delicious. But what more particularly attracted my curiosity, was that they spoke a language known to none but the natives of Kashmir, who by using a sort of note or call, took from them the power of flight ; and who were thus able to catch them by thousands at a time. On a plain in the neighbourhood frequented by thousands of these birds in a flock, by way of experiment I employed about a thousand Kashmerians, accustomed to the business, to give me a proof of their skill, and I attended in person to view the sport. As had been represented to me, about twenty of the Kashmirians collected together and produced a sort of murmuring sound, which attracting the attention of these birds, they were drawn by degrees within such a distance of the men, that they were taken in entire flocks. My pity was greatly moved by the reflection that these harmless birds should have fallen victims to this sort of treachery ; that they should have been betrayed into the hands of the destroyer by their irresistible love of harmonious sounds, and that I should be found capable of consigning them to slaughter from a mere idle and vicious curiosity ; the next day therefore I caused the whole, to the number of twenty thousand birds which had been taken on the occasion to be set at liberty. My object was attained in witnessing the fact. But to have seen them slaughtered would have bespoken of a want of compassion foreign to my nature."

It may be mentioned that the above passage is from a translation of the alleged *Memoirs of Jehangir*, from a Persian manuscript by Major David Price of the East India Company, A. D. 1829. From Appendix C to Beni Prasad's *History of Jehangir* however it now appears settled beyond doubt that Major Price's manuscript represents a forgery and that the *Tuzuk-e-Jehangiri* as published by Syed Ahmed Khan and translated by Rodgers and Beveridge forms the real Memoirs.

"Perils of Journeying in the India of the Sixteenth Century"

The Jesuit, Fr. Monserrate, who travelled from Goa to Akbar's Court at Fatehpur writes[1] in all earnestness: "Next Suiranges (Siron) was reached. The town suffers from a most unhealthy climate, as a consequence of which the cracks and dark corners of the houses are infested with all manner of poisonous vermin, which are found here in great quantities. At night also the beds are beset with scorpions whose sting brings on horrible agony. In the neighbouring marshes certain lizards are found (although indeed they are just as much at home in dry places as in marshes) whose bite is fatal. In bushes and thickets, the many coloured Regulus is found which kills by the glance of its eye. The little part of its body is red towards the head,—a more brilliant red even than scarlet—but elsewhere it is orange-coloured varying towards dark brown. It attracts the eyes of all who see it by reason of the beauty of its colouring. However, the mercy of God has decreed that its nature shall be such that if a man sees it first, the Regulus—like the wolf, if one may believe the common tale—is compelled to retreat precipitately to some hiding place where it conceals itself. But if some unfortunate man, who in ignorance of his danger is doing something else, is seen by the Regulus (which like other creatures of this class is very proud of its own beauty) some little time before he sees it, then he is bound to perish miserably, at least so the inhabitants of the region stoutly declare. One of the fathers unwittingly ran the risk of perishing in this way; for seeing the little creature, and being attracted by its beauty, he tried to catch it, and followed it till the Regulus hid itself in a thicket. When he returned to his quarters and asked the inhabitants of that place what sort of a lizard it was, that he had seen, they were no less surprised at his having escaped the glance of the Regulus than were the inhabitants of Malta at St. Paul remaining unharmed by the bite of the snake. This is roughly the size of a dormouse, and resembles the lizard called the 'chamæleon' which feeds on air and disguises itself with the colour of whatever object is nearest."

Comment on the above is needless.

Weight carried by a Camel

Jehangir records that one of his "home-bred" camels that was with him in a hunt, carried five Nilgaus that weighed 42 Hindustani maunds. (Equal to 1459½ lbs.)

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[1] *The Commentary of Fr. Monserrate* translated by Hoyland and Banerji.

The Fruits and Flowers of Hindustan

In the course of a very painstaking account of the fruits growing in the neighbourhood of Agra, Jehangir says "Of all fruits I am very fond of the mango." In regard to flowers, the Emperor writes as follows[1] "From the excellencies of its sweet-scented flowers one may prefer the fragrances of India to those of the flowers of the whole world. It has many such that nothing in the whole world can be compared to them. The first is the Chumpa (*Michelia champaca*) which is a flower of exceedingly sweet fragrance; it has the shape of the saffron flower, but is yellow inclining to white. The tree is very symmetrical and large, full of branches and leaves, and is shady. When in flower, a tree will perfume a garden."

Praises of Keora flower (*Pandanus odoratissimus*), Rae bel (presumably some sort of Jessamine), Mulsari or Bholsari (*Mimusops elangi*), Chambeli (*Jasaminum grandiflorum*), etc., follow.

"Of the trees there are the Cypress (*Sarw*), the Pine (*Sanubār*), the Chanar (*Platanus orientalis*), the White Popular (*Safidar—Populus alba*) and the Bid Mulla (willow) which they had formerly never thought of in Hindustan, but are now plentiful. The Sandal tree which once was peculiar to the islands (i. e. Java, Sumatra, etc.) also flourishes in the gardens."

"Fighting of Beasts"

Mons. de Thevenot writes in the reign of Aurangzebe[2] as follows: "There are a great many at Agra, who are curious in breeding up of beasts, to have the pleasure to make them fight together: but seeing they cannot reach to elephants and lions because it costs dear to feed them, most part content themselves with He-goats, Weathers, Rams, Cocks, Quailes, Stags and Antilopes, to entertain their friends with the fighting of these beasts."

A Method of Capturing Waterfowl

Mons. de Thevenot describes a method, still largely in vogue, in the following words: "The Indians are very dextrous at Game, they take waterfowl with great facility as thus: The Fowlers swim almost upright, yet so that they have their Head above water, which they hide with a Pot full of holes, to let in the air, and give them sight; besides this Pot is covered with feathers, to cheat the Ducks and other Fowls; so that when the Fowler draws near them they are not in the least scared, taking that floating head for a Fowl; and then the Fowler makes sure of them by their feet which he catches hold of under water and draws them down. The other ducks seeing nobody, think that their comrades have only dived, and are not at all scared; so that growing acquainted with the feathered head, that still follows them they are at length all taken, whilst in vain they stay for the return of those who have dived, before they fly away to another place."

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[1] *Jeh.*, vol. i, p. 5.

[2] *Travels into the Levant*, part iii, p. 38.

"Of the Beasts at Dehly"

In a chapter thus entitled, the same traveller says: "At Dehly are all sorts of Beasts that are known. The King hath many and private men who are rich have also some. They have Hawks of all kinds; all kinds of Camels, Dromedaries, Mules, Asses and Elephants. They have also Elks and Rhinoceroses which are as big as the largest oxen. The ordinary oxen are less than ours. Buffles they have also, and those of Bengalla are the dearest because they are very stout and are not at all afraid of lions. Nor do they want dogs of all sorts, but those which are brought from Maurenahar (Māwarā-ūn-nahar) or Transoxiane, are most esteemed for Hunting, though they may be smaller; however, the Indian Dogs are better for the Hare; they also have Stags, Lions and Leopards."

The Zebra

Jehangir thus describes this animal[1] which it is not clear from the translation whether he received from or sent to the King of Persia as offering (*circa* A. D. 1621) "At this time I saw a wild ass (*Gor-khar*) exceedingly strange in appearance exactly like a tiger. From the tip of the nose to the end of the tail and from point of the ear to the top of the hoof black markings large or small, suitable to their position were seen on it. Round the eyes there was an exceedingly fine black line. One might say the painter of fate, with a strange brush, had left it on the page of the world. As it was strange, some people imagined it had been coloured. After minute enquiry into the truth, it became known that the lord of the world was the creator thereof. As it was a rarity it was included among the royal gifts sent to (or by ?) my brother Shah Abbas."

The traveller Bernier mentions that the presents sent to the Emperor Aurangzebe by the King of Ethiopia, while the chronicler was at court, included "a small species of mule whose skin I have seen; no tiger is so beautifully marked and no *alacha* of the Indies or striped silken stuff is more finely or variously streaked."

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[1] *Jeh.*, vol. iii, p. 201.

THE CEYLON PEARL FISHERIES

BY

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and

Marine Biologist to the Ceylon Government

Pearls have always been prized for their rare beauty and value and a very considerable literature has gathered around this 'most soveraigne commoditie.' The pearl fisheries of Ceylon in particular have attracted the attention of writers in all ages, and administrators, scientists and poets alike have contributed to the literature of this fascinating subject. Pearl fisheries never fail to arouse considerable interest in Ceylon, mainly, I suspect, because they are such rare occurrences and also perhaps, because both the Government and the general public regard them as a source of revenue out of all proportion to their true value.

A pearl fishery is an event which cannot fail to strike the imagination in a variety of ways. The thought of a 'pearl town' of 20,000 to 40,000 inhabitants springing into being on one of the most desolate parts of the Ceylon coast; the sight of a fleet of hundreds of fishing boats, backed by the setting sun, sailing homewards with its precious cargo; the excitement of the auction and the babel caused by a dozen different languages being spoken at the same time; and above all, amidst the excitement and bustle of this mushroom town an effective administration with its efficient police, medical and sanitary services.

All these things have been described a score of times and it is not my intention to traverse the ground made familiar by many writers. Instead I propose to discuss some aspects of the economic problems which have been the object of researches by marine biologists during the last quarter of a century.

The natural home of the Ceylon pearl oyster is in five to ten fathoms of water on the rocky stretches to be found on the narrow submerged shelf between the shore and the hundred fathom 'overfalls' in the Gulf of Mannar. These patches of rock or 'paars' are irregular and somewhat inconstant in shape and are broken up by stretches of sand which often invades the paars. In addition the paars are surrounded by vast sandy areas. Rock is the natural habitat of the pearl oyster and the presence of sand is decidedly inimical.

The outstanding features of the Ceylon pearl fisheries are their irregularity and uncertainty. Though they possess great potential value the fisheries are intermittent and since the pearl fishery of

1891 there have been only six fisheries in thirty-six years.[1] At the beginning of the present century the Ceylon Government sought the expert advice of a distinguished marine biologist, the late Sir William Herdman, F.R.S. Professor Herdman visited Ceylon in 1902 and with that visit began a period of intensive inquiry into the bionomics of the pearl oyster which was continued by Messrs. Hornell and Southwell, and later by the present writer.

In the present paper it is proposed to deal only with the paramount problem of the intermittent fisheries. Two questions may be asked :—

(1) Why are the Ceylon pearl fisheries intermittent?

(2) Is it possible to ensure annual fisheries?

These two questions have been fully investigated in the last quarter of a century and the irregularity of the Ceylon fisheries has been ascribed to the rigorous conditions under which the Ceylon pearl oyster is said to live. Apart from the menace of disease there are two chief dangers to which the pearl oyster is exposed.

(1) *Predacious fishes* which eat the oysters and which have been known to exterminate large beds.

(2) *Sand* which encroaches upon the oyster beds resulting in their extermination.

In addition to these two chief dangers there is also the alleged danger of overfishing.

Predacious Fishes

There is no doubt that fish enemies, particularly the large rays which frequent the pearl banks in shoals, play an important part in the economy of the pearl oyster. Mr. Hornell attached special importance to this danger and went so far as to affirm that this was the 'key to the problem' of irregular fisheries. He believed the fish enemies to be the 'dominant factor in the economy of the Indian and Ceylon pearl fisheries.' He stated that the increase in predacious fishes synchronized with the rehabilitation of the pearl banks, and that the fish population eventually became so great as to disturb the balance of Nature thus bringing about the extermination of the oysters. This view does not appear to have been based upon actual experimental evidence and may be regarded as an expression of opinion and nothing more. To have obtained evidence on this point would have entailed intensive trawling operations on a scale which has not been possible before, during or since Mr. Hornell's time. One would naturally assume, however, that the fish density on the pearl banks would vary directly as the abundance of oysters and there can be no doubt that in specific cases beds of oysters have been destroyed by the action of shoals of rays. If, however, the problem of the intermittent pearl fisheries depended upon nothing more than the delicate adjustment of the balance between the degree of predacioussness of the fishes on the one hand and the measure of fecundity of the oysters on the other, as Mr. Hornell suggests, we should expect to find a similiar state of precariousness and irregularity in pearl fisheries elsewhere. As

[1] There were thirty-three fisheries in the nineteenth century.

far as can be ascertained, however, this is not the case. In the Persian Gulf, for instance, annual fisheries are the rule, and there is no reason to believe that the ravages of the rays are less pronounced in the Persian Gulf than in the Gulf of Mannar.

Mr. Hornell's claim is not very convincing, though everyone who has a working acquaintance with the pearl fishery problems will admit the seriousness of the fish menace. The obvious remedy is a campaign of intensive trawling operations, but the cost would be out of all proportion to the value of the pearl fisheries and it is by no means certain that the destruction of oysters by the heavy otter boards and nets would not be greater than that caused by the fishes themselves.

Sand

Professor Herdman expressed the opinion that shifting sand was 'the most important agent in causing widespread death of pearl oysters.' Mr. Southwell did not concur in this opinion, but my own views incline to those of Professor Herdman though I am not prepared to say that sand is more harmful than predatory fishes. There is every reason to believe that a large bed of oysters was lost in 1925 owing to the action of the sand.

Sand may be either a passive or an active danger. The mere presence of sand in the vicinity of the pearl banks is in itself detrimental as spatfalls take place equally on sand and on rock. Oysters will not thrive on sand and we may define this as a *passive* danger. Sand becomes an *active* danger when, owing to the movements of water, the sand is caught up in suspension and slowly deposited upon beds of oysters, or, as, Professor Herdman believed, is 'shifted' bodily in large masses through the powerful action of currents. There would appear to be no corrective for this active danger of silting or shifting sand, which doubtless has been responsible for the loss of many beds of oysters in the past.

In the case of a spatfall being deposited on sand (passive danger) two remedies have been suggested by Messrs. Herdman and Hornell. The first is 'cultching.' This term has been applied to the process of laying down on the floor of the sea a mixture of rock fragments, tiles, rubble, dead coral and other substances, collectively known as 'cultch', which will afford solid attachment for young oysters in places where there is an absence of rock. This process has been used for many years at Arcachon in France where the edible oyster is cultivated in shallow backwaters of the sea which are laid bare twice a day by the ebbing tide. White-washed tiles are laid down to which the young oysters attach themselves, and in this way the oysters can be farmed, cultivated and controlled as easily as a field of grain. But it would be a very difficult proposition to adapt this method to the Ceylon pearl banks where the oysters lie in comparatively deep water in the open sea. A spatfall frequently occurs over many square miles of sand and it is calculated that 10,000 to 15,000 tons of cultch would be required to cover one square mile of sea bottom. There is no guarantee that this method would provide even a temporary relief and it is quite certain that the cultch would become covered

over by sand in course of time. The process is obviously impracticable on economic grounds. It is interesting to note that cultching was begun on the Ceylon pearl banks but later was discontinued, very properly as I believe, on the advice of Mr. Southwell.

It was further suggested that transplantation should be resorted to in cases where large deposits of spat occurred on sand. In theory this would be useful, not only when a spatfall took place on unsuitable ground but also when oysters on good ground were over-crowded. I believe that transplanting has much to commend it, but like so many expedients relative to the Ceylon pearl fishery the cost would far outweigh its probable utility. Mr. Hornell, who was a keen advocate of transplanting operations, has now changed his opinion and has stated that 'with riper experience I 'have come to the conclusion that the heavy expenditure these 'means necessitate are not justifiable from a financial standpoint.'

Overfishing

From 1907 to 1925 there were no fisheries on the Ceylon pearl banks.[1] The pearl banks were leased to a public company in 1905 and the supply of oysters failed two years later. The general impression in Ceylon was that the pearl banks had been overfished by the company. This ignorance of the true state of affairs was widespread and so recently as 1925 a statement was made in the Ceylon Legislative Council that 'the company paid no 'attention whatever to the pearl banks. They tried to get as much 'as possible out of them and scraped the spat.' This recalls the charge which was made against the administration of Sir Robert Wilmot Horton in the thirties of last century of having 'caused the pearl banks to be overfished, scraped and ruined.' There was no justification for this opinion and it is most unlikely that overfishing has ever been practised on the pearl banks. Under the present system of diving, which has remained unchanged for many hundreds of years, it would be difficult to overfish even if one were so inclined. The late Sir William Twynam, K.C.M.G., who had an unrivalled knowledge of the Ceylon pearl fisheries based upon thirty-five years' experience, wrote as follows in 1899: 'I do not 'concur in the least with those who cry out that the banks are or 'have been overfished and consequently that no oysters have been 'left to breed and replenish the banks. The divers do not and 'cannot clear away all the oysters on a bank at a fishery.' It is safe to assume that the divers leave at least five per cent of the oysters. Far from overfishing being a danger it is much more likely that many a fine bed of oysters has perished undiscovered and unfished owing to the old surveys being inaccurate on account of the inadequacy of the land marks. The sudden disappearance of oysters after the 1907 fishery was certainly not due to overfishing. Capt. Kerkham, Superintendent of Fisheries, informed me that he discovered a compact bed of oysters in 1908, but the season

[1] This is not a record as some people think. A similar gap occurred from 1837 to 1855.

was too far gone to arrange a fishery and when the next inspection was made it was found that the oysters had died of old age.

Both Professor Herdman and Mr. Southwell believed overfishing to be a danger though the former made no recommendations to meet it. Mr. Southwell expressed the opinion that the denudation of the banks was due to overfishing and to the attacks of predatory fishes. As a remedy he proposed to establish breeding reserves and he advocated the protection of young oysters by laying down sheets of wire netting over the oysters. The provision of breeding reserves can be justified only if overfishing is feared, but enough has been said already to show that such fears are groundless. Consequently, I do not believe that breeding reserves are necessary.

To sum up briefly what has been said in the preceding pages. The peculiarly intermittent nature of the Ceylon pearl fisheries has been attributed to a variety of causes chief amongst which are the effects of predacious fishes, the action of sand and overfishing. I cannot believe that these agencies, either individually or collectively, are responsible for the unfortunate state of affairs though they may be, and doubtless are, a contributory cause. To counteract the harmful effects of predatory fishes recourse must be had either to intensive trawling or to Mr. Southwell's proposed wire-netting protection; to meet the harmful action of sand both cultching and transplanting have been suggested. All these proposals are correct enough in theory but they would prove impracticable if applied to the Ceylon pearl banks, and they can be dismissed once and for all from an inquiry which is searching for practical and economic remedies. As I hold that the charge of overfishing cannot be maintained the recommendations about breeding reserves may be dismissed. If the views stated above are correct the united efforts of the workers of the first two decades of this century failed both in indicating the true cause of the many unprofitable periods which characterize the Ceylon pearl banks and in suggesting a remedy. It cannot be said that a very convincing case has been made out to show that fishes and sand have any *vital* relation to the main problem and I would go even so far as to say that if all predatory fishes were cleared from the pearl banks and if sand and other inimical factors were eliminated we should still retain this unfortunate heritage of irregular fisheries.

I regard the true cause of these irregular fisheries as a geogrphical one. The Ceylon pearl banks are situated on a narrow shelf between the deep 'overfalls' and the shallow inshore waters. The Cheval Paar, for instance, covers an area of about 25 square miles of rock surrounded by hundreds of square miles of sand. This paar is only five miles from the shore on its eastern boundary and a similar distance from the 100 fathom line on its western border, narrow enough confines for the habitat of an organism which spends the first few days of its life floating in the surface water and which can only establish itself successfully on rock in depths of five to ten fathoms. The pearl oyster becomes sexually mature at the age of twelve months and thereafter has two sexual periods in each year, but there is no guarantee that a bed of oysters, once established, will produce a spatfall within the circum-

scribed limits of the pearl banks. The floating larvæ are at the mercy of the elements and no human effort can influence or control the course which these larvæ may follow in the few days of their pelagic life. An abnormal monsoon, a change in the current, or any one of a hundred other factors might be sufficient to prevent the young oysters from being deposited on the rocky paars of the pearl banks. They might be carried out into the deep water beyond the overfalls where, even if they did not perish, they would be beyond the reach of the divers; or, on the other hand, their course might be directed shoreward in which case they would come to grief in the coastal shallows.

The expedients which have been discussed in the early part of this paper had reference mainly to the care and protection of oysters which had already established themselves in the paars, but such remedies would avail nothing if the progeny of these oysters, born in uncountable millions twice a year, ultimately found themselves deposited on unfavourable ground where they would be doomed to early destruction. The fate of the spatfall, therefore, is one of momentous importance. If the Ceylon pearl banks consisted of a wide stretch of paar ground it would be reasonable to expect annual fisheries, but as things are—a narrow shelf of rock 'between the devil and the deep sea,' and pelagic larvæ whose migrations cannot be directed or controlled—it would appear to be beyond the wit of man to devise a remedy.

It is ironical that so simple an explanation offers no solution, but it is clear that the nearer this explanation approaches the true one the more unsatisfactory would the proposals discussed in this paper appear to be. My predecessors clearly held the view that the Ceylon pearl banks had a bright future before them. Even in the dark days of 1911 when the pearl banks were barren and the Ceylon Company of Pearl Fishers ceased to function Mr. Southwell, believing that a spatfall was imminent ventured the opinion that, given a spatfall 'only thorough inspection, care and normal fore-'sight in isolating breeding stocks, etc., are required to make the 'banks perennially productive.' Mr. Southwell was engaged in scientific work with the company in 1907 when their last fishery took place. From what I know of Mr. Southwell's work I feel sure that all the conditions laid down in the above quotation were faithfully carried out by him. It is certain that a large natural breeding reserve was left after the 1907 fishery, as Capt. Kerkham discovered a compact bed of oysters in 1908. Why then, have the pearl banks not been 'perennially productive' since 1907? The explanation would appear to be that the last spatfalls were not deposited in adequate numbers on the pearl banks but fell on unfavourable ground.

The present condition of the pearl banks confirms in a striking manner what has been said about the importance of the spatfall. From 1919 to 1923 there were successive spatfalls and in 1924 there were some thousands of millions of oysters of various ages on the banks, but since the end of 1923 there has not been a single spatfall of any magnitude although there were enormous numbers of oysters on the banks. It may be anticipated, therefore, that

the present series of oysters which first made their appearance on the banks in 1919 will die out in 1929 if no further spatfall takes place, as there has not been a successful spatfall since 1923. It may be said, incidentally, that although there are large numbers of oysters scattered over the banks at present, forming an excellent breeding reserve, they do not occur in sufficient numbers and in sufficient density to justify a fishery. Under present conditions if all harmful agencies such as fishes and sand were removed the banks would become barren about 1829 unless we are fortunate enough to have a spatfall in the next year or so.

It would appear, therefore, that the intermittent fisheries will continue to characterize the Ceylon pearl banks, and the banks will never become 'perennially productive' because we cannot control the course of ocean currents or direct the destiny of the floating oyster larvæ by the application of scientific principles. To quote the words written nearly a century ago by a former Inspector of the Ceylon pearl banks, 'Unsuccessful intervals will continue 'to recur . . . . . we cannot cause the spawn to settle down upon 'nourishing ground. These are events beyond the control of man. 'The winds, the waves, and the uncertain currents of the ocean 'carry the embryo over unlimited space. It is only when in the 'infinite wisdom of the Creator of all things, the oyster brood 'descends upon the banks . . . . . that it comes within our limited 'power . . . . . to fish up the respective deposits as they approach 'the proper age.' In my opinion the case could not be summed up better than that.

I have confined my remarks to what may be regarded as the fundamental problems, which concern the economic prosperity of the Ceylon pearl banks, and in so doing I have been forced to ignore much of the valuable work of my predecessors. It is a thankless task to offer criticisms of other people's work and it would have been much more congenial to have had the opportunity of bearing testimony to the valuable advances in marine biology which we own to Herdman, Hornell and Southwell. With regard to the application of marine biological science to the economic problems of the Ceylon pearl fisheries it must be confessed that, whatever may be the cause of the peculiar uncertainty of the pearl fisheries, we have all failed to find a remedy. In the opinion of my predecessors the remedy is in man's hands; in my opinion there is no solution. It is not an easy matter to have to confess that marine biology can offer no solution of this most interesting problem but my own examination of the matter, extending over more than fifteen years, does not permit me to come to any other conclusion with the evidence at hand.

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., PH.D., F.L.S.

PART IV
GRAMINEÆ

BY

E. BLATTER and C. MCCANN

(*Continued from page 33 of this volume*)

21. IMPERATA, Cyr.

Species 5 or 6, nearly allied. In the warm regions of both hemispheres.

Imperata cylindriaca, Beauv. Agrost. 165, t. v, fig. 1, Explan. planch. 5 ; Cyr. Pl. Rar. Neap. Fasc. ii, 26, t. ii ; Hack. Monogr. Androp. 92 ; Boiss. Fl. Or. v, 452 ; Duthie Grass. N. W. Ind. 14 ; Indig. Fodd. Grass t. 15 ; Fodd Grass. N. Ind. 22 ; F. B. I. vii, 106 ; Cke. ii, 946 ; Haines Bot. Bihar and Orissa, pt. v, 1015 ; Stapf in Fl. Trop. Afr., ix, 87.--*I. Koenigii*, Beauv. Agrost. 165.--*Saccharum cylindricum*, Lam. Encycl. i, 594 ; Roxb. Fl. Ind. i, 234 ; Grah. Cat. Bomb. Pl. 239 ; Griff. Notul. iii, 80.—*S. europaeum et S. indum*, Pers. Syn. i, 103.—*S. Ravennæ*, Bieb. Fl. Taur. Cauc. iii, 51.

Some authors distinguish varieties and subvarieties which scarcely seem to be justified. Stapf who mentions two varieties (var. *Thunbergii*, Durand & Schinz, and var. *Koenigii*, Durand & Schinz) says in a note (l. c. 89) : 'The varieties and the type, although on the whole pretty distinct within their areas, often pass into each other, chiefly along the confines of their areas, or they possibly lose their distinctive characters under particular local conditions, when the separation becomes almost impossible.' This does not speak in favour or good varieties. Hackel (l. c. 93–95) has 3 varieties and several subvarieties, and Anderson (in Oefvers. K. Vet. Akad. Forh. Stockh. 1885, p. 157) is still more liberal with his subvarieties. Hook, f. makes one variety *latifolia* (F. B. I. l. c.) and remarks about one of Hackel's varieties : 'Hackel distinguishes the Indian form as var. *Koenigii* having villous nodes and broader, less rigid leaves, but some of the Indian specimens appear to me quite like the Western Hackel's division depends chiefly on such characters as hairiness of the leaf-insertions, width of the leaves and height of the ligule. The height and shape of the ligule, however, seems, according to Hole's investigations, more or less correlated with the width of the lamina, while the other characters appear to vary with the locality and do not define forms of any constancy. Hole's treatment of *Imperata arundinacea* (On Some Indian For. Grasses and their Oecology, 1911, p. 95) appeals to us much more. Amongst the material observed at Dehra Dun he distinguishes 3 forms which are more or less clearly defined :--

(*a*) The depauperate form common on lawns or areas where the grass is continually cut or grazed, with minute, almost filiform, culms and small leaves. Leaf-insertions usually long-bearded. Glume IV and pale usually glabrous.

(*b*) The ordinary savannah form which usually attains a height of about 90 cm. with leaves up to 17 mm. wide. Leaf-insertions bearded or glabrous. Pale and glume IV ciliate.

(*c*) A robust form found in swamps or marshy soil where there is an abundance of available moisture more or less throughout the year. This plant attains a height of 2·8 m. and probably more. Leaves up to 26 mm. wide, leaf-insertions glabrous. Pale and glume IV ciliate. This is identical with var. *latifolia*, Hook. f.

Forms of this kind could be multiplied according to various localities. As we are not going to distinguish any varieties we give a description of the species including all the variations that so far have been observed.

Description :—Culms erect, simple, slender, from 12 cm. in height and almost filiform to 2·8 m. high and 8 mm. diam., 3–4–noded, glabrous, solid, slightly fistular at base : leaf-insertions tumid, glabrous or densely bearded with erect white hairs. Leaf-sheaths rather loose, glabrous or glabrescent, ciliate or glabrous along the margin towards apex, the lowest at length usually breaking up into fibres, usually longer than proper internode ; ligules membranous, rounded, truncate or 2-lobed, ciliate, dorsally silky, attaining a height of 3 mm. Blade of uppermost leaf of flowering culm from mucroniform and 1·25 mm. long to 15 cm. long and 6 mm. wide with greatest width in middle, of lower leaves erect or arcuate and attaining a length of 1·2 m. and width of 27 mm., greatest width about the middle, dark green, midrib white, apex acuminate, narrowed towards the base where the midrib occupies almost the entire width of the leaf, smooth, but scabrid on margin and on one or more sub-marginal nerves above, especially towards the apex, white villous above on margins towards the base and behind the ligule. Panicle spike-like, 3-50 cm. long, not exceeding 25 mm. in width, cylindric, very dense ; branches and branchlets very numerous, crowded, appressed ; pedicels fine with clavate tips, glabrous, scaberulous or pubescent, with long fine hairs below. Flowering panicle purple with the exserted stigmas, the callus-hairs being closely appressed to the axis, fruiting panicle silvery white with the wide-spreading callus-hairs. Spikelets not awned, lanceolate, 3 mm. long, both spikelets of each pair similar, each 1-flowered and hermaphrodite, and at length falling from the pedicel ; callus-hairs soft, white, 2–3 times as long as the spikelets. Lower involucral glume lanceolate, membranous, slightly thickened towards the base, apex hyaline, 3–9-nerved, none of the nerves extending to apex of glume, margins incurved ciliate above, dorsally villous with soft white hairs overtopping the glume by 1½ to 3 times the length of the glume. Upper involucral glume similar and subequal to the lower, but sometimes sub-keeled with mid-nerve extending almost to apex. Lower floral glume oblong, hyaline, nerveless, apex acute or subtruncate and laciniate or denticulate, ciliate, ½ to ¾ of the upper involucral glume. Upper floral glume subequal to the lower one, ovate-lanceolate, hyaline, nerveless, apex acuminate, acute or obtuse and laciniate or denticulate, minutely ciliate or glabrous. Pale quadrate, rectangular or subpentagonal, hyaline, nerveless, apex denticulate or unequally laciniate, glabrous or ciliate, ½ the size of the upper floral glume or subequal to it. Lodicules none or very minute. Anthers 2, 2·5–3 mm. long, orange, filaments sometimes connate below. Stigmas 2, 3-4 mm. long, purple.

Locality : Sind : (Stocks).—*Gujarat :* (Graham).—*Konkan :* Tardeo, Bombay (Hallberg 5398 !) ; Alibag, sandy shore (Ezekiel !) ; near Thana (McCann !); Banks along railway track between Ghatkoper and Thana, Salsette (McCann !).—*S. M. Country :* Shiggaon (Sedgwick 2353 !); Dwararji (Sedgwick and Bell !); Castle Rock (Bhide !) ; Londa, common (McCann !).—*Kanara ;* Halyal (Talbot 1896 !).

Distribution : The hotter parts of India, ascending in the Himalayas to at least 6,500 feet, Mediterranean region ,Africa, Java, Japan, China, Australia.

Biology and Ecology : See Hole, l. c. 96.

Uses : Duthie says of this grass that ' cattle relish it '. ' In Australia,' he says, ' it is called blady grass and the young succulent foliage which springs up after the occurrence of a fire is much relished by stock. I have observed the same effect resulting from periodical fires on certain parts of the Himalaya where this grass is plentiful.' (Duthie, Fodd. Grass. of N. Ind. 23). ' In India,' according to Hole (l. c. 101) ' the succulent white stolons are eaten by pigs and areas which have been well-worked by pigs in their search for the stolons are not infrequently seen in the forest. It is possible that in some cases the eradication of the species might be cheaply accomplished by the aid of pigs.'

This grass is also known as a paper-making material : ' The ultimate fibre obtained from this grass is very similar in most respects to Esparto ; the yield of bleached fibre being about the same. This is a favourable indication inasmuch as Esparto is one of the best known and most useful sources of supply to the trade. The results obtained from the chemical analysis show that the grass is capable of yielding a good quality of cellulose, suitable in every way for the manufacture of paper.'[1]

The leaves are largely used for thatching (Hole).

[1] *Agric. Bull. of the Straits and F. M. States*, vii (1908), 586.

22. SACCHARUM, Linn., Stapf Fl. Trop. Afr. ix, 94

The genus as understood by the latest agrostologists comprises also the species which were formerly described under the genus *Erianthus*, Michx. As already remarked by Haines in his Flora of Chota Nagpur the awned upper floral glume of some *Saccharum* breaks down the only distinction between *Saccharum* and *Erianthus*.

Cooke (ii, 948) mentions 3 species of *Saccharum*: *T. spontaneum*, Linn., *S. arundinaceum*, Retz. and *S. officinarum*, Linn. To these we add *S. Munja*, Roxb. and *S. Griffithi*, Munro. The two species of *Erianthus*, observed in the Presidency, viz. *E. Ravennæ*, Beauv. and *E. fastigiatus*, Nees, will be transferred to *Saccharum*.

General characters of *Saccharum*: Perennial tall herbs. Leaves various. Panicle large, often silvery-silky and showy, spikelets usually surrounded by long silky hairs from the base, all alike, binate, one sessile, the other pedicelled on the articulate fragile rhachis of panicled racemes, the pedicelled falling from their pedicels, the sessile deciduous together with the contiguous joint of the rhachis and pedicel. Florets 2, the lower reduced to an empty valve, the upper hermaphrodite. Involucral glumes equal, often chartaceous to subcoriaceous towards the base, membranous to subhyaline upwards; the lower glume with inflexed margins and in the sessile spikelet usually with an even number of nerves; upper glume 1-, 3-, or 5-nerved. Floral glumes hyaline; upper with a terminal bristle-like usually straight awn, or mucronate, or muticous, or 0. Lodicules 2, cuneate. Stamens 3. Stigmas laterally exserted. Grain oblong to subglobose; embryo short to half the length of the grain or more; hilum basal.

Key to the species, mainly after Haines.

A. Awn of upper floral glume not or scarcely exserted from spikelets or 0.
  I. Hairs on callus of sessile spikelet much exceeding the spikelets
    1. Culms not leafy above, under 17 mm. diam. Leaves under 20 mm. broad. Lower Involucral glumes ciliate ... ... 1. *S. spontaneum.*
    2. Culms densely leafy above, over 25 mm. diam. Leaves over 25 mm. broad. Lower Involucral glumes glabrous ... 2. *S. officinarum.*
  II. Hairs on callus of sessile spikelet shorter or not much longer than spikelet
    1. Upper involucral glume of sessile spikelet not villous dorsally
      (*a*) Foliage not glaucous. Culms densely leafy above. Sessile spikelet shorter than internodes of rhachis ... ... 3. *S. arundinaceum.*
      (*b*) Foliage glaucous. Culms not leafy above Sessile spikelet longer than internodes of rhachis ... ... 4. *S. munja.*
    2. Upper involucral glume of sessile spikelet villous dorsally ... ... 5. *S. Griffithii.*

B. Awn of upper floral glume distinctly exserted from the spikelet
  I. Panicles thyrsiform. Spikelets 3–4 mm. long. Awn 2·5 to almost 6 mm. long ... ... 6. *S. Ravennæ.*
  II. Panicles not thyrsiform. Spikelets 4 to almost 5 mm. long. Awn 8 mm. long ... 7. *S. fastigiatum.*

In the following treatment of the various species we shall draw largely on R. S. Hole, On some Indian Forest Grasses and their Oecology, in *Indian Forest. Memoirs*, vol. i, pt. 1 (1911), 50–91.

1. **Saccharum spontaneum**, Linn. Mant. (1771), 183; Roxb. Fl. Ind. i (1832), 235; Griff. Ic. Pl. As. t. 139, f. 63; Dalz. and Gibs. 304; Duthie Grass. N. W. Ind. 15, Indig. Fodd. Grass. 57, Fodd. Grass. N. India, 25; Hack. Monogr. Androp. 113; Hook. f. F. B. I. vii, 119; Cke. ii, 948; Hole in Ind. For. Mem. i, pt. 1, (1911), 50; Haines Bot. Bihar and Orissa (1924), 1011.—*S. semidecumbens*, Roxb. l. c. 236.—*S. canaliculatum*, Roxb. l. c. 246.—*S. chinense*, Nees in Hook. et Arn. Beechy's Voy. 241.—*S. ægyptiacum* var. *sinense*, Anders. in Oefvers. K. Vet. Akad. Förhand. Stockh. (1855), 157 (*non S. sinense*, Roxb.). —*S. spontaneum*, Linn. subsp. *ægyptiacum* var. *nepalense*, Hackel, l. c. 116.—Rheede Hort. Malab. xii, t. 46 (probably).

We have not included the synonyms which Stapf Fl. Trop. Afr. ix, 95, has given under *S. spontaneum* var. *ægyptiacum*, Hack: as we are not in a position to judge whether it is a good variety or not. According to Hole the African forms placed under var. *ægyptiacum* differ from the Indian plants chiefly by their slightly larger spikelets. But he finds that this difference is very slight and that it fails in the case of some African specimens. 'Considering the great variability of the species in India it seems possible that a more complete knowledge of the African plant will prove *ægyptiacum* to be merely one of the several oecological forms which are defined by inconstant characters and which are connected by numerous intermediates.'

Description :—Stem erect or decumbent at the base, reaching up to 6 m. in height and 15 mm. in diam., solid above, fistular below, terete, indistinctly striate, usually pruinose when young, polished when old, silky below the panicle and minutely silky below the upper leaf-insertions, glabrous or minutely pubescent below the lower leaf-insertions. Leaf-sheath longer than proper internode, often with reddish or purplish blotches, villous at mouth, often minutely pubescent at base, otherwise glabrous or with scattered appressed hairs, sulcate. Blade erect, of uppermost leaf of flowering culm usually long, varying from 5 cm. to 90 cm. in length, of lower leaves up to 1·2 m. and even 2 m., usually very narrow, often not exceeding 1·5 mm. in width and then consisting of a very narrowly margined cancavo-convex midrib, but also attaining a width of 16 mm. glaucous, midrib white, margin scabrid, often villous above at base immediately behind the ligule. Ligule ovate or deltoid, base often sub-auricled, membranous, subacute or subtruncate, often fimbriate when old, up to 6 mm. high, minutely silky dorsally and ciliate. Flowering panicle 15–60 cm. long, conical or lanceolate to oblong, branches horizontally spreading or slightly ascending, usually reddish or purplish, with the callus hairs closely appressed to the branches of the panicle ; primary rhachis sulcate, silky with long white hairs ; primary branches subverticillate, simple or compound. Spikelets in pairs, one pedicelled and one sessile on the capillary jointed branches and branchlets, awnless, lanceolate, 2–5 mm. long, sessile and pedicelled similar, each one-flowered and hermaphrodite, pedicelled fruiting spikelet falling from the pedicel, the sessile spikelet falling later with the attached pedicel and joint of axis ; joint of axis longer or shorter than sessile spikelet, villous on margins, or on margins and dorsally ; pedicel $\frac{1}{4}$–$1\frac{1}{4}$ the length of the sessile spikelet, but usually shorter than spikelet, glabrous or ciliate, shorter than proper joint ; callus-hairs white, from $1\frac{1}{2}$–7 times as long as sessile spikelet. Lower involucral glume lanceolate, the basal third thickened, becoming hard and polished in fruit and more or less brown in colour, the upper two-thirds membranous hyaline, with 2 lateral nerves from which the margin is inflexed ; apex entire or minutely bidentate ; margin ciliate ; dorsally with the upper two-thirds minutely appressed-pubescent. Upper involucral glume broad-lanceolate, similar to the lower, but subkeeled with one central nerve ; apex sometimes mucronate ; margin inflexed and long—ciliate. Lower floral glume hyaline, nerveless, shorter than upper involucral glume, ovate-lanceolate, long—ciliate, minutely pubescent above dorsally. Upper floral glume minute, linear, ciliate, hyaline, sometimes 0. Pale minute, ovate, ciliate, often shorter than the lodicules. Lodicules 2, cuneate, glabrous or ciliate at apex. Anthers 3, yellow, turning brown. Stigmas 2, purple.

'The horizontally spreading callus-hairs of the fruiting spikelet form an efficient parachute which aids its distribution by wind. The hairs of neighbouring spikelets becoming entangled together, characteristic flocculent masses of several spikelets are often seen being carried by the wind or hanging on the adjacent vegetation.' (Hole).

As good field characters we may mention the narrow leaves and slender culms, the long callus-hairs and the brown coriaceous base of the involucral glumes.

This is a very variable species, and Hole does not think that we are justified in making different sub-species or varieties. He distinguishes 3 ecological forms :

(*a*) The dry sandy soil-form, a xerophilous type. The culms are slender, erect and tufted, usually less than 5 mm. diam. The leaves exceedingly narrow, sometimes only a little more than 1 mm. wide. The callus-hairs not less than $3\frac{1}{2}$ times the length of the spikelet.

(*b*) The swamp form, a hygrophilous type, found in marshes and swamps with an abundance of available moisture more or less throughout the year. The culms are stout, 5–15 mm. diam., usually decumbent at base and not tufted. Leaves broad, reaching a width of 17 mm.

The callus-hairs $1\frac{1}{2}$–$3\frac{1}{2}$ times as long as the spikelets. The fruiting panicle elongate-elliptic to oblong with its branches usually more persistent than in other forms.

(*c*) The loam-form, intermediate between (*a*) and (*b*). The culms are more or less decumbent at the base and not tufted, but less robust and with longer callus-hairs than in (*b*).

Locality: Sind: Shikarpur (Woodrow) ; Mirpur Sakro (Blatter and McCann D697 !).—*Gujarat :* Baroda (Cooke) ; Domas near Surat (Dalzell and Gibson).—*Khandesh :* Dadgaum (McCann 9892 !) ; Northern slope of Chanseli (McCann 9893 !); Bor, Bori River (Blatter and Hallberg 4422 !);—*Konkan :* Kamana, Mahim (Ryan 2205 !); Sakwar, river side (Ryan ? 2080 !); Bassein (Ryan 4 !); Karjat (Woodrow), on river bank (McCann !); Vihar Lake (McCann 9,894 !); Alibag, sandy shore (Ezekiel !).—*Deccan :* Igatpuri, on banks of bund (McCann 4334 !); Poona, river bank (Woodrow).—*S. M. Country :* Banks of streams, common in the S. Dharwar District (Sedgwick and Bell 3693 !); Haveri (Talbot 2236 !); Castle Rock (Gammie 15743 !, McCann !); Belgaum (Ritchie).—*Kanara :* Suppa, bed of Kala Nuddi (Talbot 2196 !) ; Hullikal (Talbot 1348 !).

Distribution of the species, irrespective of the varieties : Africa (Upper Guinea, Nile Land, Mozambique District), Lower Egypt, Arabia, Syria, Afghanistan, India, Ceylon, Burma, China, Java, Philippines, New Guinea, Australia.

Uses : A favourite fodder of buffaloes. The leaves are used for thatching and brooms. Valuable as a fixing agent for shifting sand and unstable soil. For *S. spontaneum* as a potential source of paper plup see W. H. Brown and A. F. Fischer. Philippine forest products as sources of paper pulp, in Forest. Bur. Philipp. Islds. Bull. 16 (1918).

* 2. **Saccharum officinarum**, Linn. Sp. Pl. ed 1, 54 ; Roxb. Fl. Ind., i, 237 ; Beauv. Agrost. Explan. planch. 5, t. iv, fig. 10 ; Hack. Monogr. Androp. 111 ; Hook. f. in F. B. I. vii, 118 ; Cke. ii, 948 ; Haines Bot. Bihar and Orissa 1012 ; Stapf Fl. Trop. Afr. ix, 96.

Description : Stems up to 6 m. high, many-noded, glabrous or pubscent below the panicle, more or less coated with wax below the nodes. Leaf-sheaths tight, terete, smooth, glabrous except when young ; ligules very short, membranous, ciliate ; blades linear-lanceolate, up to 1·5 m. long and over 5 cm. broad green above, glaucous below, more or less scabrid along the margins, midrib very stout, rounded on the back, more or less flat above. Panicles pyramidal, up to 1 m. long, dense, silvery ; primary rhachis glabrous except on the pubescent nodes, or more or less silky ; primary branches verticillate or semiverticillate, very slender, glabrous or hairy. Racemes up to 10 cm. long, very fragile ; joints and pedicels filiform, more or less ciliate or glabrous, the joints variable in length, the pedicels much shorter. Spikelets lanceolate, up to 4·2 mm. long, surrounded from the callus by a tuft of long silky hairs up to 9 mm. long. Involucral glumes subequal, lanceolate, firm towards the base, otherwise subhyaline the lower acute, 2-nerved to sub-4-nerved, glabrous, the upper very similar, 1-3-nerved, glabrous or ciliolate. Lower floral glume oblong, acute or subacute, hyaline, nerveless, ciliate, about 3·3 mm. long, upper floral glume subacute, ciliate, as long as the lower or 0. Pale, if present, very minute, obovate, ciliate. Lodicules broad, cuneate, sparingly ciliolate from the top. Stigmas purplish. 2·1 mm. long. Grain oblong, attenuated upwards, subterete, flesh-coloured ; embryo $\frac{1}{6}$ the length of the grain.

Locality : Grown throughout the Presidency.

Origin :—There are many indications that S. Asia is the original home of the sugarcane.

* 3. **Saccharum arundinaceum**, Retz. Obs. bot. fasc. IV (1786), 14 ; Hackel Monogr. Androp. 117, excl. syn. *S. exaltatum* ; Hook. f. in F. B. I., vii. 119 excl. syn. *S. ciliare*, Anders., *S. exaltatum*, Roxb., *S. munja*, Roxb., *S. Sara* Roxb.; Cke ii, 948, excl. syn. *S. exaltatum*, Roxb.; Haines Bot. Bihar and Orissa, 1012. *S. bengalense*, Retz. l. c. v., 16. *S. procerum*, Roxb. Fl. Ind., i, 243.

Description : A gigantic tufted grass. Culms biennial (? or triennial), somewhat with the habit of the sugarcane, branched, often 5 m. high, the flowering culms sometimes nearly 9 m. high and over 18 mm. diam., solid. Stem glabrous, smooth, or slightly rough with very long internodes. Blade reaching 1·8 m. in length and 5 cm. in breadth, with rib stout and as broad as the blade at base, keeled below, villous with long silky hairs above, margins

cutting. (According to Hole the midrib in basal leaves occupies at base ⅓ or less of the width of the blade). Upper cauline leaves becoming folded and filiform. Leaf-sheaths glabrous. Ligule truncate with a ring or tuft of long silky hairs 6–25 mm. distance from its base. Panicle 60 cm. to 1·2 m. long, pink, white or silvery, diffuse while flowering, with smooth glabrous axis, main branches tufted on the axis, tufts alternate or subverticillate. Spikelets 2·5–3·7 mm. long, much shorter than the internodes of the spike. Pedicel ⅓ to equal the length of the sessile spikelet. Joint usually longer than sessile spikelet ; majority of pedicels shorter than proper joint. Callus-hairs pale, not dense, as long as spikelet (according to Hole shorter than or subequal to spikelet). Hairs of joint overtop the joint by less than to 1½ times the length of the joint. Sessile spikelet : Lower involucral glume chartaceous, dorsally sparsely villous, villi overtopping the glume by about 1¼ the length of the glume. Upper involucral glume chartaceous, not villous dorsally. Lower floral glume not villous dorsally. Mucro of upper floral glume not exserted beyond apex of spikelet. Pale ciliate. Pedicelled spikelet : Involucral glumes dorsally villous, villi overtopping spikelet by 1–1½ times the length of the spikelet. Spikelet sometimes 2–3-flowered with 1-2 additional paleate glumes inside the floral glumes.

Locality : Cultivated in gardens.

Distribution : Bengal, Assam, Burma, extending into China. It is a native of the evergreen zone of India characterized by a rainfall exceeding 70 in., but is frequently cultivated in gardens throughout India. (Hole).

4. Saccharum munja, Roxb. Fl. Ind. i (1832), 246 ; Hole in Ind. For. Memoirs, I (1911), 62 ; Haines Bot. Bihar and Orissa 1013.—*S. Sara,* Roxb. l. c. 244.—*S. ciliare,* Anders. in Oefvers. K. Vet. Akad. Förhand. Stockh. (1855), 155 ; Hackel Monogr. Androp. 118, excl. vars. *Griffithii et Boissieri.*—*S arundinaceum,* Hook. f. in F. B. I., vii, 119 (*partim*).—*S. arundinaceum,* var. *ciliare,* Haines in Fl. Chota Nagpur.

For explanation of above synonymy see Hole, l. c. 65–67.

Description : An erect grass, attaining a height of 5·5 m. and 12 mm. diam., pale straw-coloured, smooth, striate, solid. Leaf-sheath shortly silky at extreme base, otherwise quite smooth, striate, pale straw-coloured, villous on margins at apex with long white hairs usually much longer than proper internode, uppermost sheath sometimes extending beyond the base of the panicle. Upper leaf of flowering culm 22–70 cm. long, flat, tapering from the base, long-acuminate, 5–10 mm. broad. Lower leaves up to 2 and 2·4 m. by 25 mm., but usually only 18 mm. broad. In basal leaves the concave midrib occupies ½ or more of width of blade. Colour glaucous, midrib white. Margin scabrid as are one or more intramarginal nerves below, otherwise smooth, but densely white villous at base behind the ligule. Ligule truncate, usually a narrow membranous rim, of upper leaves longer, attaining 3 mm., minutely silky dorsally and ciliate. Flowering panicle 30–90 cm. long, usually lanceolate, pale cream-coloured to dark reddish-purple, branches spreading. Fruiting panicle oblong, branches appressed to the axis, white to greyish-white. Primary rhachis glabrous, sulcate, more or less scabrid on the ridges. Primary branches subverticillate, compound. Ultimate branchlets triquetrous, more or less villous with long white hairs on angles and on two faces. Spikelets in pairs, one pedicelled and one sessile on the capillary jointed branches and branchlets of a terminal panicle, awnless, lanceolate, up to 5 mm. long ; sessile and pedicelled similar, each one-flowered and hermaphrodite. Pedicelled fruiting spikelet falling from the pedicel, the sessile spikelet falling later with the attached pedicel and joint of axis. Joint of axis triquetrous, ½ to subequal the sessile spikelet, but usually shorter than the spikelet, villous on two faces and on margins, the villi overtopping the joint by once to twice the length of the joint. Pedicels triquetrous, ⅓–¾ the length of the sessile spikelet, villous with long white hairs on two faces and on the angles. Most pedicels shorter than proper joint, rarely subequal to the proper joint. Sessile spikelets : Lower involucral glume lanceolate, chartaceous, with two strong lateral nerves and usually 1-4 more or less distinct additional nerves, dorsally long villous on basal half or two-thirds, the hairs overtopping the glume by about the length of the glume, scabrid dorsally on keels, margin inflexed, sparsely ciliate above, apex minutely bidentate to entire. Upper involucral glume subequal to the lower, lanceolate, chartaceous, keeled, with one strong central

nerve and usually 2–4 more or less distinct additional nerves, glabrous dorsally or minutely pubescent towards apex, scabrid dorsally on keel, margins incurved, ciliate above, apex usually shortly mucronate. Lower floral glume oblong-lanceolate, hyaline-membranous or little shorter than the upper involucral glume, 1–3-nerved, margins incurved, ciliate, apex acute or short mucronate. Upper floral glume broad-lanceolate to elliptic, shorter than or subequal to the upper involucral glume, hyaline, 1-3-nerved, mucronate, ciliate, mucro short to 1·25 mm. long, but not exserted beyond the apex of the spikelet. Pale ovate, hyaline, ciliate, from $\frac{1}{3}$–$\frac{3}{4}$ the length of the upper floral glume. Pedicelled spikelets similar, but both the involucral glumes are dorsally long villous and usually with 3-5 strong nerves and occasionally 2 additional fainter ones. Lodicules 2, cuneate, glabrous, 0·5 mm. long. Anthers 3, pale yellow to purple, 2–2·5 mm. long. Stigmas yellow, often tinted with purple, 1–1·5 mm. long.

To distinguish this species from *Saccharum Ravennæ* Hole gives the following field-characters : Glaucous narrow leaves, awnless spikelets, smooth leaf-sheaths.

Locality : *Sind* (Stocks in herb. Boiss. ex Hackel).—*Gujarat* :– (Sedgwick and Sexton).

Distribution : Northern India in the Punjab and Upper Gangetic Plain.

Uses : The fibre of the upper leaf-sheaths is used for mats, ropes, etc. It has also been favourably reported on as a paper material (Haines).

5. **Saccharum Griffithii,** Munro ex Aitchis. in Journ. Linn. Soc. xix (1822), 191 ; Hole in Ind. For. Memoirs i (1911), 68–70.—*S. Sara,* Aitchis, l. c. 191 ; Boiss. Fl. Or. v, 453.—? *S. Griffithii,* Boiss l. c. 453,—*S. ciliare* var. *Griffithii* Hackel Monogr. Androp. 119.—*Erianthus Griffithii* Hook. f. in F. B. I. vii, 122 (*partim*).

Description : A cæspitose grass. Culms 2 m. high or slightly higher, solid. Blade glaucous, narrow, about 8 mm. wide ; midrib at base usually occupies $\frac{1}{2}$ or more of width of blade ; sheath not hirsute, nodes not bearded. Rhachis of racemes fragile. Spikelets 2 at each node of the rhachis, one sessile and finally decidous with the accumbent joint, the other pedicelled finally separating from the pedicel, both 1-flowered, hermaphrodite. Spikelets 4-6 mm. long, muticous ; pedicel $\frac{1}{3}$–$\frac{2}{3}$ the length of the sessile spikelet ; joint $\frac{1}{4}$–$\frac{2}{3}$ the length of the sessile spikelet. Most pedicels subequal to longer than proper joint ; callus-hairs yellow, shorter than to subequal to the spikelet ; hairs of joint overtopping joint by once to twice the length of joint. Sessile spikelet : Lower involucral glume chartaceous, dorsally densely villous in basal $\frac{2}{3}$, villi not overtopping the glume, or overtopping by less than $\frac{1}{4}$ the length of the glume. Upper involucral glume chartaceous, dorsally villous in basal $\frac{1}{2}$ or $\frac{2}{3}$, villi not overtopping or overtopping by less than $\frac{1}{4}$ the length of the glume. Lower floral glume sometimes sparsely villous dorsally. Upper floral glume with a very short mucro, 1·5 mm. long, not exserted beyond apex of spikelet. Pale ciliate. Pedicelled spikelet : Involucral glumes dorsally villous in basal $\frac{1}{2}$–$\frac{2}{3}$, villi not overtopping or overtopping by less than $\frac{1}{2}$ the length of the spikelet ; no additional glumes inside the floral glumes.

Locality : *Sind* :—Near Hyderabad (Blatter and McCann D698 !); W. of Tatta (Blatter and McCann D699 !); near Karachi (ex Hackel l.c.).

Distribution : Afghanistan, Baluchistan, Punjab, Sind.

6. **Saccharum Ravennæ,** Linn. Syst. ed. xiii, 88 ; Sibth. & Sm. Fl. Græca, t. 52 ; Reichb. Ic. Fl. Germ., fig. 1505 ; Stapf Fl. Trop. Afr. ix, 97 ; Haines Bot. Bihar and Orissa 1014.—*Erianthus Ravennæ,* Beauv. Agrost 162 ; Roem. and Schult. Syst. ii, 323 ; Hack. Monogr. Androp. 139 ; Hook. f. F. B. I. vii, 121 ; Stapf in Kew Bull. (1907), 208 ; Nees Gen. Fl. Germ. t. 90 ; Boiss. Fl. Or. vi, 455 ; Duthie Grass. N. W. Ind. 15, Fodd. Grass. N. Ind. 26 ; Cke. ii, 949 ; Hole in Ind. For. Memoirs, i (1911), 87.—*Andropogon Ravennæ,* Linn. Sp. Pl. ed. ii, 1481 ; Host. Gram. Austr., iii, 1, t, 1.—*Ripidium Ravennæ,* Trin. Fund. 169.

Description : Culms erect, up to 6 m. high and 17 mm. thick, solid, often slightly fistular just below the panicle, smooth and polished, striate, shortly and finely bearded at the leaf insertions. Leaf-sheath hirsute with bulbous-based hairs, the latter varying in colour from white to yellow or brown, the hairs being more or less deciduous and old sheaths are often rough with the persistent bulbous bases ; upper sheaths glabrescent, always longer than the proper internode, long ciliate on margins towards the apex. Blade of uppermost leaf of flowering

culm from 20 cm. long and 6 mm. wide, linear and tapering from base, to 75 cm. long and 16 mm. wide with greatest width about the middle ; lower leaves usually 1·2–1·5 m. long and 25 mm. wide, but also attaining a length of 1·8 m. and width of 38 mm., broadest about the middle, sometimes in upper third, dark green, midrib white, apex acuminate, narrowed towards the base, in basal leaves the concave midrib occupies ½ or more of width of lamina at base, often the entire width of the leaf, densely villous above towards the base with bulbous-based hairs, more or less scaberulous along nerves, margins scabrid. Ligule a narrow membranous rim not longer than 1·75 mm., entire, rounded or deeply 2-lobed, patently hairy dorsally with stiff white hairs, ciliate. Panicle 30–90 cm. long, lanceolate, dense or somewhat lax and lobed, silvery silky, with a tinge of grey and purple, or quite white ; primary rhachis sulcate, glabrous, smooth below, scabrid on the ridges ; branches slender, solitary from the distant nodes, divided from the base, up to 20 cm. long, branchlets unequal, divided again, glabrous except at the nodes. Racemes sessile or the lower more or less peduncled, narrow to oblong ; joints and pedicels filiform, long ciliate, with thickened tips, the latter shorter than the joints. Callus-hairs shorter than to subequal to length of spikelet, purplish or brownish. Sessile spikelet : Lower involucral glume lanceolate with 2 lateral keels, dorsally flat or depressed between the keels, apex 2-mucronulate, one or both margins incurved, dorsally scabrid on keels, otherwise glabrous, or more or less villous dorsally, villi not overtopping the glume, or overtopping by less than ½ the length of the glume, 2-nerved, sometimes with 1–2 additional faint nerves between the keels. Upper involucral glume subequal to the lower, with a central keel, mucronate, margin incurved, ciliate, dorsally scabrid on keel, otherwise glabrous or more or less villous dorsally, villi not overtopping the glume, or overtopping by less than ¼ the length of the glume, 1-nerved and sometimes 1 or 2 partial lateral nerves. Lower floral glume slightly shorter than upper involucral glume, oblong-lanceolate, hyaline, apex mucronate or acute, dorsally glabrous , margin incurved, ciliate above, 1-3-nerved. Upper floral glume usually ¾ the length of the lower, ovate-lanceolate, hyaline, margin incurved, ciliate, long-awned, awn 2·5–6 mm. long, 3-nerved. Pale about ¾ the length of the upper floral glume, ovate-lanceolate, hyaline, glabrous, nerveless. Lodicules 2, cuneate, glabrous. Anthers 3, yellow streaked with purple. Stigmas yellow. Pedicelled spikelet like the sessile, but involucral glumes often strongly 3-nerved and hairy.

Can easily be distinguished from *Saccharum munja* by its distinctly awned spikelets, the broader dark green leaves and hairy leaf-sheaths. (Hole).

Locality : Sind—Laki (Bhide !) ; Khairpur Mirs, sandy plain (Sabnis B226 !) ; Sehwan (Sabnis B36 !, B664 !) ; Larkana (Sabnis B444 !, Cooke) ; Pad-Idan (Sabnis B498 !, B509 !) ; Sukkar (Sabnis B552 !) ; Nasarpur, sandy plains (Sabnis B1049 !) ; Umarkot, sandy plains (Sabnis B1211 !) ; Sanghar (Sabnis B900 !) ; Jamesabad (Sabnis B968 !) ; Phuleli Canal, on banks (Sabnis B195 !) ; Mirva Canal, sandy banks (Sabnis B258 !) ; Khairpur forests (Sabnis B329 !) ; Sita Road (Sabnis B367 !) ; Sehwan to Laki, foot of hills (Sabnis B60! , B111 !) ; Mirpur Sakro (Blatter and McCann D694 !) ; Chuar Chemali (Blatter and McCann D695 !) ; Indus Delta (Blatter and McCann D696 !) ; Karachi (Cooke, Woodrow).—*Deccan* : College Garden, Poona (Garade !).

Distribution : Western Himalaya, Punjab, Upper Gangetic Plain, Sind, extending westwards to the Mediterranean.

Uses : The culms are used for making screens, etc. The leaves quickly decay and are therefore useless for thatching.

7. **Saccharum fastigiatum,** Steud. Syn. Gram. (1855), 409 ; Haines Bot. Bihar and Orissa, 1014. *Erianthus fastigiatus*, Nees ex Steud. l. c. ; Hack. Monogr. Androp. 150 ; Hook. f. in F. B. I., vii, 125 ; Cke. ii, 949.

Description : Cke. l. c.

Locality : S. M. Country :—Belgaum (Ritchie 792).

Distribution : Sikkim, Khasia, Assam, Bengal, Chota Nagpur, Orissa, W. Peninsula.

23. SPODIOPOGON, Trin., Cke. ii, 947.

Spodiopogon albidus, Benth. in Journ. Linn. Soc. 19 (1881), 66 ; Hackel Monogr. Androp, 185 ; F. B. I. vii, 108 ; Cke. ii, 947.—*Andropogon rhizophorus* Steud. Syn. Gram. 381 ; Duthie Fodd. Grass. N. Ind. 26.—*Andropogan petiolatus*, Dalz. Bomb. Fl. (1861), 303.

Description : Cke ii, 947.

Locality : *Khandesh :* Toranmal (McCann 9886 !, 9888) ;—*Konkan :* W. Ghats (Woodrow 157) ; Warsai, near Penn (Bhide !) ; Penn (McCann 5374A !) ; Below Palli Hill, Bandra (Ryan !) ; Tungar, Bassein (Bhide !) ; Salsette (Jacquemont 708) ; Matheran (Cooke) ; Matheran, Harrison's Springs (D'Almeida A242 !).—*Deccan* : Lonavla (Bhide !, McCann !, Woodrow) ; Khandala, very common (McCann, 9491 !) ; Khandala to Karjat (Blatter and Hallberg 5325 !); Ganeshkhind Bot. Gardens, Kirkee (Gammie !) ; Sinhagad Forest, Poona District (Bhide !) ; Lohagad, upper half (McCann 9437 !) ; Purandhar Fort (McCann 5004 !); Igatpuri, common (McCann 4327); Mahableshwar (Cooke); Mahableshwar to Pratapgad (Bhide 1182 !).—*S. M Country :* Derikop, forest (Sedgwick 1862 !).—*Kanara :* (McCann !) ; Arbail Ghat (Sedgwick and Bell 3168 !) ; Suppa (Talbot, 279 !).

Distribution : Central Provinces, Rajputana, W. Peninsula.

24. Pogonatherum, Beauv., Cke. ii, 965.

1. Hairs of callus longer than the spikelet...1. *P. crinitum.*
2. Hairs of callus shorter than the spikelet...2. *P. saccharoideum.*

1. **Pogonatherum crinitum**, Kunth Enum. Pl. I (1833), 478 ; Hook. f. in F. B. I. vii, 141 ; Cke. ii, 965.—*P. saccharoideum* var. *monandrum*, Hack. Monogr. Androp. 193.—*P. polystachyum*, Kunth Revis. Gram. 493.—*P. refractum*, Nees in Hook. et Arn. Beechy's Voy. 239.—*Pollinia monandra*, Spreng. Syst. i. 288.—*Pogonopsis tenera*, Presl. Rel. Hænk. i, 133, t. 46.—*Ischæmum crinitum*, Trin. in Mem. Acad. Petersb. ser. vi, ii (1833), 298.—*Andropogon crinitus*, Thunb. Fl. Jap. 40, t. 7.—*A. monandrus* Roxb. Fl. Ind. i, 260.—*Pogonatherum*, Griff. Notul. iii. 81, Ic. Pl. As. t. 145, fig. 2.

Description : Cke. ii, 965.

Locality : *Kanara :* Sirsi (Gammie !); Sumpkund, in a cutting (McCann 9947 !, Woodrow !); Nilkhund Ghat on steep bank along roadside (Talbot 781 !) ; Gersoppa Falls (Talbot 2671 !, McCann, 9939 !).

Distribution : More or less all over India, Afghanistan, China, Malaya, New Hebrides.

*2. **Pogonatherum saccharoideum,** Beauv. Agrost. 56, t. 11, fig. 11 ; Duthie Grass. N. W. Ind. 16, Fodd. Grass. N. Ind. 27 ; F. B. I. vii, 141 ; Cke. ii, 966 ; Haines Bot. Binar and Orissa, 1017.—*P. saccharoideum* var. *genuinum*, Hack. Monogr. Androp. 193.—*P. polystachyum*, Roem. and Sch. Syst. ii, 497.—*Pollinia polystachys*, Spreng. Syst. i, 288 ; Kunth Rev. Gram. 493, t. 162.—*Saccharum paniceum*, Lamk. Encycl. i, 595, illust. t. 40. fig. 31.—The Bamboo Grass.

Description : A much tufted, branched and very leafy elegant grass, 30–60 cm. high ; stem firm or almost woody, slender, polished, from a perennial woodstock ; nodes on stem glabrous or bearded. Leaves 2·5–6·5 cm. long up to 2·5 mm. broad, linear, acuminate, bearded at the base and margins of sheaths. Spikes 17 mm. to 5 cm. long, terminating all the branches ; rhachis compressed and pedicel bearded ; each spikelet with 2 long fine scaberulous awns 15–25 mm. long. Sessile spikelet : Lower involucral glume narrow-oblong, broadest above, faintly 2-4-nerved, tip bearded. Upper involucral glume the largest, conduplicate, 2·5 mm. long, 1-nerved, keel produced into a long awn, tip densely ciliate. Lower floral glume sometimes absent. Pale of upper floral glume broadly ovate-oblong, much exceeding the minute ovary. Pedicelled spikelet about ¾–¾ the length of the sessile.

Locality : Grown in gardens.

Distribution : Hilly parts of India from the Punjab to Bhutan, Burma and China, southwards to Central India and Ceylon, Malaya.

25. Eulalia, Kunth ; Stapf Fl. Trop. Afr. ix, 97.

(Formerly under *Pollinia*, Trin.—Cke. ii, 950).

Perennial. Culms simple, erect or ascending. Leaf-blades convolute when young, then flat, usually narrow, gradually passing into the sheath. Racemes often coloured, brown or purplish. Spikelets all alike or nearly so, one sessile, the other pedicelled on the articulate fragile rhachis of 2-nate, digitate or fascicled spike-like racemes, the pedicelled falling from their pedicels, the sessile deciduous together with the contiguous joint of the rhachis and the pedicel. Involucral glumes equal or somewhat unequal, rigidly membranous to coriaceous, the lower dorsally flattened or shallowly concave (never grooved),

more or less 2-keeled with inflexed margins, the upper 1-3-nerved, keeled. Lower floral glume empty, sometimes much reduced, muticous, hyaline ; upper floral glume very short, 2-lobed, awned, pale small or 0. Lodicules small, cuneate. Stamens 3. Stigmas linear, laterally exserted. Grain oblong ; embryo almost half the length of the grain or longer ; hilum basal, punctiform.

Species about 25, in the tropical and subtropical regions of the Old World.

1. Racemes many, 6–12.....1. *E. argentea.*
2. Racemes few, 2–4 .....2. *E. fimbriata.*

1. **Eulalia argentea**, Brogn. Voy. Coq. Bot. 92 ; Haines Bot. Bihar and Orissa, 1018.—*Pollinia argentea*, Trin. in Bull. Sc. Acad. Petersb. i (1836), 71 ; Hackel Monogr. Androp. 162 ; Hook. f. in F. B. I. vii, 111; Cke. ii, 950. — *P. tristachya*, Thw. Enum. Pl. Zeyl. 368 (*partim*) ; Duthie Fodd. Grass. N.W. Ind. 26, t. 53.—*Erianthus hexastachyus*, Hochst. in Hohen. Pl. Ind. Or. no. 279. —*E. Roxburghii*, F. Muell. Fragm. Phyt. viii, 117.—*Andropogon tristachyus*, Roxb. Fl. Ind. i. 256.

Description: Cke. ii, 950.

Locality: *Khandesh* : Tapti Valley, railway line (Bhide !).—*Konkan :* Ratnagiri (Woodrow) ; Near Ratnagiri (Herb. Econ. Bot. Poona !) ; St. Xavier's College compound, Bombay (McCann 4510 !) ; Parsik Hill (McCann 9715 !) ; above Kenery Caves (McCann 9723!) ; Ghatkoper, Horse-shoe Valley (McCann 9891 !) ; Marine Lines, Bombay (Hallberg 9889 !) ; Bassein (McCann 9475 !) ; Vetora (Sabnis 33507 !).—*Deccan :* Lonavla (Bhide !, McCann !, Woodrow, Lisboa) ; Khandala, very common (McCann 9716!) ; Lohagad, way up (McCann 9718 ! ; Panchgani (Blatter 5388 !, Blatter and Hallberg B. 1213 !, McCann !) ; Mawal (Woodrow).—*S. M. Country :* Dharwar District (Sedgwick 2112 !) ; Dastikop (Sedgwick 2088 !) ; Castle Rock (Bhide !, McCann A. 304 !).— *Kanara*: Suppa Taluka(Talbot 2257!); Jugglepet(Talbot 1569!); Yellapore (Talbot 1525!); Halyal (Talbot 2224 !); Kumberwada (Talbot 2257 !) ; Dandeli (Talbot 2267 !).

Distribution : Throughout India, Ceylon, Malaya, Australia.

2. **Eulalia fimbriata**. Blatter and McCann, *comb. nova.—Pollinia fimbriata*, Hackel Monogr. Androp. 164 ; Hook. f. in F. B. I. vii, 112 ; Cke. ii, 950.

Description : Cke. l. c.

Locality : Konkan : Dahe Forest (Ryan 708 !); Uran (McCann, 5123!) ; Trombay (McCann 305 !) ; Matheran, Monkey Point (D'Almeida A. 254 ! , A. 255 !).—*Deccan :* Lonavla (Chibber 11 !, Woodrow 173) ; Khandala, common (McCann 5300 !).

Distribution. W. Himalaya, W. Peninsula, Pegu.

26. Sorghum, Pers. Syn. i, 101 ; Stapf Fl. Trop. Afr., ix, 104.

Annual or perennial, often robust, grasses. Leaf-blades convolute in bud, usually flat, herbaceous, often large. Panicles erect or nodding with verticillate or scattered branches, often large, in the spontaneous species mostly loose, in the cultivated forms frequently variously contracted to compact. Spikelets 2-nate, those of each pair differing in shape and sex, one sessile, the other pedicelled or represented by a pedicel only, on the articulate fragile or (in cultivated forms) tough rhachis of panicled few-(sometimes-1 or, the other extreme, 6–8-) jointed racemes, the sessile spikelet falling with the contiguous joint and the accompanying pedicelled spikelet or at least its pedicel. Florets 2, lower reduced to an empty valve, upper hermaphrodite in the sessile, male or neuter in the pedicelled spikelets, if present at all. Sessile spikelet : Involucral glumes equal, coriaceous, at least when mature, rarely permanently chartaceous, muticous. Lower with a broad flattened or convex back with the margins narrowly inflexed near the tips and elsewhere involute. Upper cymbiform with narrow hyaline, usually upwards ciliate margins. Lower floral glume empty, hyaline, ciliate, 2-nervedor nerveless. Upper oblong to ovate, 1–3-nerved, 2-lobed or dentate, with the lobes free or more or less adnate to a perfect or variously reduced awn or a mucro rising from the sinus, rarely entire and mucronate or muticous. Pale hyaline, often minute or 0. Lodicules 2, ciliate or glabrous. Stamens 3. Stigmas laterally exserted ; styles terminal or subterminal. Grain in the wild species mostly obovoid, dorsally compressed, in cultivated forms frequently enlarged, globose or subglobose ; embryo as long or slightly longer than half the grain. Pedicelled spikelets, if present, much narrower than the sessile, lanceolate to subulate, male or neuter

sometimes reduced to the glumes or one glume only or quite suppressed. Involucral glumes permanently herbaceous, awnless like the hyaline 2–1-nerved ciliate floral glumes.

According to Stapf (Fl. Trop. Afr., ix, 105) there are about 35 wild species in the tropical and subtropical regions of both hemispheres, very few extending into the temperate zones. One group of forms is widely cultivated in the tropics, particularly in Africa.

The classification of the material belonging to the section *Eu-sorghum* forms a difficult problem, which we are not prepared to tackle at present. The difficulties are well explained by Stapf (l.c.), and we cannot refrain from quoting the passage, though somewhat lengthy, because it may be a help to workers on this genus and induce them, at the same time, to subject the vast material available in the Presidency to a more scientific examination and exact taxonomic treatment, by which Botany as well as Agriculture will profit.

Those species, says Stapf, ' which come under consideration in this work (Flora of Tropical Africa) have with two exceptions (*S. purpureo-sericeum* and *S. versicolor*) been placed by Hackel in one vast species, *Andropogon Sorghum*, the leading idea being that they were all derived from one wild ancestor, the old *Holcus halepensis*, Linn. Piper, however, has recently advanced good reasons why this is extremely improbable. He has pointed out that the Linnean *Holcus halepensis* (*Andropogon Sorghum*, subsp. *halepensis*, var. *genuinus*, Hack.) is a perennial type almost confined to the Mediterranean region (*sensu lato*) and absent from tropical Africa which is the home of most of the spontaneous annual forms and probably also the cradle of most of the cultivated races known collectively as Guinea corn (*Andropogon Sorghum*, subsp. *sativus*, Hack.). To these spontaneous annuals and the cultivated forms he confines the name *Andropogon Sorghum*, and dealing in particular with the former he groups them under 11 subspecies, whilst he abstains from attempting to classify the latter. Most of Piper's subspecies are here recognized as definite units, but with the status of species, a procedure which seems to have the advantage of simplicity and directness, whilst it leaves the door open to any theoretical grouping which may in the future be desirable. The same reasoning has been applied to the cultivated forms. Hence the breaking up of Hackel's *Andropogon Sorghum*, var. *sativus*. Koernicke, who made the first comprehensive attempt to classify them, relied for that purpose exclusively on characters exhibited by mature infructescences, especially their degree of looseness or contraction and the colours of the ripe glumes and grains ; but Hackel in his monograph introduced characters taken from the shape of the spikelets . The grain being in most cases the thing aimed at in the evolution of these very numerous races, it is clear that artificially introduced modifications must from the beginning have tended in the grain-state to obscure or repress the phytogenetically important features in so far as they were economically indifferent or undesirable. It seemed therefore, more promising to base the primary grouping on the comparison of the flowering stages, which might be expected to be more or less outside the influence of the artificially moulding forces of man. Within these primary groups, which are treated here as species, nothing more than a purely artificial arrangement can for the present be attempted. An exhaustive treatment of the hundreds of races which have been given distinctive popular names would, even if it were possible, be beyond the scope of a colonial flora.'

If Stapf, with all the facilities of Kew and the British Museum and other European herbaria at his disposal, complains about ' the very rudimentary state of our knowledge and of our collections ' nobody can reasonably expect that we should bring order into the chaotic state of the *Sorghum* question in India. Years of intensive study of Indian and African forms are required to bring the intricate problem nearer its solution.

For the present we follow Haines in retaining the old species of *S. halepense* and *S. vulgare*. Of species not known from the Presidency before we add *S. subglabrescens*, Schweinf. & Aschers. and *S. nitidum*, Pers. This, we admit, is not quite satisfactory, but it is all we can offer at the present state of our knowledge and with the material at our disposal in India.

In order to enable Indian botanists to utilize Stapf's and Piper's investigations in the further study of the genus *Sorghum* we shall add, in the way of an appendix, the descriptions of those species which Stapf has described from tropical Africa and which have also been observed in India, whether in the

Presidency or outside it. It is only in this way that we shall be able to co-ordinate the knowledge obtained on so widely spread a genus like *Sorghum* and it would not help botanical science to start the investigations of Indian *Sorghums* on independent lines without constant reference to the work done in other fields. It might be easier and perhaps also more convenient for certain practical purposes, but on the whole certainly less scientific and in the long run more confusing.

A. Wild species
  I. Racemes up to 4-noded
    1. Primary branches of panicle divided
      (*a*) Stems up to 4·5 m. high ... 1. *S. halepense.*
      (*b*) Stem about 75 cm. high ... 2. *S. subglabrescens.*
    2. Primary branches of panicle simple ... 3. *S. purpureo-sericeum.*
  II. Racemes 2–8-noded ... ... 4. *S. nitidum.*
B. Cultivated species ... ... 5. *S. vulgare.*

1. **Sorghum halepense**, Pers. Syn. i (1805), 101.—*Andropogon halepensis*, Brot. Fl. Lusit. i (1804), 89; Hook. f. in F.B.I. vii, 182; Cke. ii, 983; Haines Bot. Bihar and Orissa 1033.

Vern. Names : Boru, baru ; called Johnson Grass in America.

Description : Cke. l. c.

Locality : Gujarat : Ahmedabad (Gammie 16389 !) ; Perim Isl., Gulf of Cambay (Blatter 3813 !).—*Khandesh :* Toranmal (McCann 9643 !) ; Khadgaum (McCann 9642 !).—*Konkan :* Bassein Fort (Chibber 138 !) ; Kase forest, Dhann Range (Ryan 1919 !) ; Vetora (Sabnis 33072 !) ; Trombay (McCann A. 269 !) ; Byculla (McCann 9656 !).—*Deccan :* Ganeshkhind Botanic Gardens (Herb. Econ. Bot. Poona !) ; Purandhar (McCann 5001 !); Khandala, railway line near Rama's Bed (McCann 9426 !) ; Panchgani (Blatter and Hallberg B. 1302 !).—*S. M. Country:* Kunnur, 2,000 ft., rainfall 35" (Sedgwick and Bell 4984 !) ; near Kilgerry (Talbot 2617 !).—*Kanara :* Halyal Fort (Talbot 2006 !).

Distribution : Most warm countries.

Uses: A good fodder grass. The grain is eaten. See Vinalle, H. N. : A study of the literature concerning poisoning of cattle by prussic acid in *Sorghum*, Sudan grass and Johnson grass, Journ. Amer. Soc. Agron. 13 (1921), 267–80. Gives remedies for hydrocyanic acid poisoning.

2. **Sorghum subglabrescens**, Schweinf. & Aschers. in Beitr. Fl. Aethiop. 302, 306 ; Stapf in Fl. Trop. Afr. ix, 137.—*Andropogon subglabrescens*, Steud. Syn. Pl. Glum. i, 393.—*A. Sorghum*, subsp. *sativus*, var. *subglabrescens*, Hack. in Monogr. Androp. 519 ; Chiovenda in Ann. Istit. Bot. Roma vii, 25.

Description : Annual. Culms (Stapf saw only a meagre specimen) slender, almost simple, 75 cm. high, about 8-noded, internodes, except the uppermost, shorter than the sheaths. Leaf-sheaths finely pubescent at the nodes ; ligules very short, shortly ciliate from the back ; blades linear from a broad (middle and upper leaves) or slightly narrowed (lower leaves) base, long-attenuated upwards, up to 20 by 1·7 cm., green, flushed with red, quite glabrous. Panicle oblong, erect, 8·5 by almost 2·5 cm., contracted, moderately dense ; branches scattered, erect, the longest not much over 2·5 cm., long and undivided for about 12 mm. from the base, almost simple, scabrous to spinulously ciliate, sparingly hairy at the base. Racemes tough, up to 4-noded and 8·5-10·6 mm. long, dense ; joints rather stout, up to 2 mm. long, shortly whitish-ciliate ; pedicels very similar, up to 1 mm. long. Sessile spikelet oblong, actue in flower, broad-ovoid or ellipsoid in fruit, 6·3 by 3·3 mm., at length variegated, awned ; callus-beard scanty, 1 mm. long. Involucral glumes equal, gaping when mature, more or less coriaceous and glossy in the lower third, spongy-subcoriaceous and constricted about the middle, then papery, more or less whitish strigillose, at length sometimes almost glabrous ; lower finely 13-nerved, nerves showing above the coriaceous base, keels rather sharp, scabrid, running into minute teeth, between which the minute hyaline tip protrudes, the coriaceous part rich maroon to almost black, followed by a pale transverse zone, then violet or purple across the middle, the broad triangular somewhat depressed tip straw-colour or reddish upwards ; upper glume almost as broad as the lower, 9-nerved, slightly keeled, coloured like the lower. Floral glumes ciliate; lower broad-oblong, up to almost 5·3 mm. long ; upper ovate, subentire, 3·3 mm. long, awn up to 12·7 mm. long, sharply bent, column stout, twisted, equalling the bristle. Grain exposed

upwards between the gaping glumes, equalling or slightly exceeding them, obovoid, 4·2 mm. long, more or less orange; embryo-mark and nerves obscure. Pedicelled spikelet neuter, persistent, linear-lanceolate, acute, 5·3 mm. long and more, reddish, lower involucral glume up to 11-, upper 7-nerved.

Locality : Mahratta Country (Young, ex Stapf).

Distribution : Abyssinia, tropical Arabia.

Note : According to Stapf the specimen from India is a smaller variety of the type just described.

3. **Sorghum purpureo-sericeum**, Aschers. & Schweinf. in Schweinf. Beitr. Fl. Aethiop. 302, 306; Stapf in Fl. Trop. Afr., ix, 140.—*Andropogon purpureo-sericeus*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii (1851), 469; Hack. in Monogr. Androp. 524; Hook. f. in F. B. I. vii, 185; Cke. ii, 984.

Description : Cke. l.c.

Locality : Gujarat: Garvi Dangs, in a field (Herb. Econ. Bot. Poona !).—*Khandesh* (Herb. Econ. Bot. Poona !); Bhusawal (McCann 5224 !).—*Deccan :* Poona, above the Ghats (teste W. Burns).—*S. M. Country :* Kolhapur (Woodrow !); Belgaum (Ritchie 887).—*Kanara* : N. Kanara (Woodrow 40 !).

Distribution : Central Provinces, W. Peninsula, tropical Africa.

4. **Sorghum nitidum**, Pers. Synops. i, 101; Haines Bot. Bihar and Orissa 1034. —*Andropogon nitidus*, Kunth, Revis. Gram. i, 166.—*A. serratus*, Thunb. Fl. Jap. 41; Hack. in Monogr. Androp. 520.—*Anatherum nitidum*, Spreng. Syst. i, 290.—*Andropogon fuscus*, J. S. Presl in C. B. Presl, Reliq. Haenk. i, 342.—*A. consimilis*, Steud. Syn. i, 394.—*A. pedicellatus*, Steud. l. c. 394.—*Holcus fulvus*, R. Br. Prodr. 199.—*Sorghum fulvum*, Beauv. *ap.* Roem. *et.* Schult. Syst. ii, 840.—*Chrysopogon fuscus*, Trin. in Steud. Nomencl. ed. 2, 360.

Description : A tall tufted grass, 1-2·4 m. high, densely villous at the nodes. Leaves 10–75 cm. by 8–20 mm., setaceously acuminate, glabrous or sparsely hairy on both surfaces, hairs often tubercle-based, midrib broad, prominent, white; sheaths terete below, keeled upward, more or less hairy; mouth silky-villous; ligule very short, truncate. Panicle 10–30 cm. long, oblong, lax, subsimple, rhachis glabrous, branches capillary, about equalling the spikes, glabrous or scaberulous, whorls distant. Spikes 8–37 mm. long, red-brown; joints and pedicels ½ to ⅔ the length of the sessile spikelets, margins shortly villous. Sessile spikelets broadly ellipsoid, callus rounded (Haines), or acute (Hook. f.). Lower involucral glume coriaceous, broadly oblong or elliptic acute or obtuse, dorsally flattened with incurved margins, brown-hairy and keels hispid, 7-nerved, or about 3-nerved between keels, sometimes nearly black, polished. Upper involucral glume broadly cymbiform with rounded back, lanceolate, acute, 1-nerved, hairy upwards. Lower floral glume as long as or shorter than the upper involucral glume, hyaline, margins inrolled, 2-keeled, ciliate; upper floral glume linear-oblong, 2-lobed, awned or not. Pedicellate spikelet linear-oblong, pale or greenish with brown hairs. Lower involucral glume oblong, rounded or sub-truncate, dorsally depressed and 2-nerved between the keels; upper equal, rather narrower, obtuse margins much inflexed, 3-nerved between keels. Lower floral glume hyaline, linear.

Locality : Kanara : Tinai (Talbot 2574 !); Sambiani (Talbot 1337 !); Sirsi to Sidderpur (Hallberg and McCann A 270 !).

Distribution : India, Ceylon, Nicobars, Asia, tropical Australia.

5. **Sorghum vulgare**, Pers. Syn. i, 101; Haines Bot. Bihar and Orissa 1033. —*Andropogon Sorghum*, Brot. Fl. Lus. i, 88.

Description : Stout, usually tall annual grasses. Leaves broadly linear with a prominent white midrib. Panicle usually thyrsiform decompound with crowded whorls of erect branches and branchlets, rarely subeffuse. Rhachis of spike tenaceous, joints when forcibly separated leaving a ragged scar at the tip. Pedicelled spikelets usually neuter, pedicels short.

This is the Great Millet or Jowar, cultivated in most parts of the Presidency. (See H. H. Mann, Fodder Crops of W. India. *Dept. Agr. Bombay, Bull.* 77 of 1916, and G. L. Kottur, Classification and Description of the Jowars of the Bombay Karnatik, *Dept. Agr. Bombay Bull.* 92 and others.)

After what we have said above we do not consider it advisable to enter into a description of the numerous varieties and forms. But we may mention in this place that a variety common in the Presidency, viz. *S. vulgare* var. *Roxburghii*, Hackel in Monogr. Androp. 510 has been described as a species by Stapf under

the name of *S. Roxburghii* in Fl. Trop. Afr., ix, 126. The description will be given in the following appendix to the genus *Sorghum*.

Species of *Sorghum* described from Africa by Stapf which also occur in India. All the information is taken from Stapf, mostly almost verbatim.

A. Mature sessile spikelets deciduous with the adjoining joint of the rhachis and its pedicelled companion : spontaneous grasses — 1. *S. verticilliflorum*.

B. Mature sessile spikelets persistent : cultivated grasses

I. Mature glumes wholly coriaceous or the lower with a herbaceous triangular tip, its nerves not visible on the back except at the tip, particularly when this is herbaceous

1. Mature panicles more or less loose, usually with arched or drooping branches, never quite compact

(*a*) Sessile spikelets ovate or elliptic to lanceolate-oblong

* Mature spikelets pale straw-colour, permanently more or less hairy ; the grain embraced below by the tightly appressed glumes ... — 2. *S. Roxburghii*, var. *semiclausum*.

** Mature spikelets bright tawny early glabrescent ; the grain almost wholly exposed between the involute glumes... — 2. *S. Roxburghii*, var. *hians*.

(*b*) Sessile spikelets broadly obovate in outline ... — 3. *S. bicolor*, var. *obovatum*.

2. Mature panicles very dense to compact, rarely more or less loosened owing to the reduction of the primary axis and the consequent subdigitate arrangement of the branches ... — 4. *S. Durra*.

II. Mature glumes thinly crustaceous to papery, the tips brittle and breakng irregularly. Back of spikelets longitudinally striate.

1. Sessile spikelets 6·3–8·5 mm. long. Pedicelled spikelets 7·6–10 mm. long ... — 5. *S. papyrascens*.

2. Sessile spikelets 5—6·3 mm. long. Pedicelled spikelets up to 6·3 mm. long — 6. *S. cernuum*.

* 1. **Sorghum verticilliflorum.** Stapf in Fl. Trop. Afr. ix. 116 —*S. halepense*, Nees Fl. Afr. Austr. 88, *non* Pers.—*Andropogon verticilliflorus*, Steud. Syn. Pl. Glum. i, 393.—*A. Sorghum*, subsp. *halepensis*, var. *effusus*, Hack. in Monogr. Androp. 503 (*partim*).—*A. Sorghum verticilliflorus*, Piper in Proc. Biol. Soc. Wash. xxviii, 37.—*A. halepensis*, var. *effusus*, Stapf in Dyer, Fl. Cap. vii, 346 (*partim*).

Description : An annual. Culms 1·2–2·4 m. high, sometimes slightly pruinose below the nodes. Leaf-sheaths delicately silky-pubescent at the nodes ; ligules up to over 2 mm. long, scarious, hairy on the back ; blades linear from a broad rounded and often clasping base, long attenuated upwards, up to 45 cm. long, rarely over 25 mm. wide, green, sometimes slightly glaucous or flushed with purple, hairy just behind the ligule, otherwise glabrous. Panicle oblong to ovoid-oblong, often rather contracted and more or less nodding at first, then spreading out and more erect, up to 37 cm. long and ultimately 15–22 cm. wide ; branches slender, flexuous, whorled, longest up to 22 cm. long and undivided to up to 5, rarely 7·5 cm. from the base, distantly branched, slightly and shortly hairy to villous at the base, like the branchlets more or less rough, at least upwards. Racemes fragile, up to 5-, but mostly 2- or 3-noded, rarely over 18 mm. long ; joints slender, 3·3–4·2 mm. long, shortly ciliate, cilia dirty white or pale fulvous, often with a tinge of purple ; pedicels similar, slightly shorter, their tips subdiscoid. Sessile spikelet ovate to ovate-lanceolate, shortly acuminate to acute, 3·7–4·5 mm. by 1·5–2·2 mm., straw-coloured, greenish towards the tips (at least when young), sometimes tinged with purple, ultimately

often turning bright or blackish-red particularly below; callus-beard less than 1 mm. long. Involucral glumes equal, coriaceous, slightly glossy below (more so when opening), thinner upwards, lower usually slightly bulging below and somewhat depressed towards the tips, 11-13-nerved, with the nerves very obscure near the tips or more or less marked, sharply 2-keeled and scabrid to spinulously ciliolate in the upper half or third, more or less strigillose, often glabrescent, rarely almost glabrous, hairs pale whitish or fulvous, loosely appressed, upper sharply keeled towards the tips with the keel rough, 7-nerved, more or less hairy. Floral glumes conspicuously ciliate, lower lanceolate, 5·3 mm. long, upper ovate, shortly 2-lobed, 2·2 mm. long; awn fine, 1·3-1·7 cm. long. Anthers 3·3 mm. long. Grain obovate-oblong, 3·3 mm. by 0·2 mm., fuscous, paler below; embryo-mark distinct, hardly exceeding the middle of the grain. Pedicelled spikelet male or neuter, early deciduous, subulate-lanceolate to linear, acutely acuminate, 6·3 mm. long, pale greenish often tinged with red or purple; lower involucral glume 0-, upper 5-nerved.

Distribution: Nileland, Mozambique District, Natal, the Comoros, Seychelles, Madagascar, the Mascarenes. Introduced into India as Tabucki grass, also to Australia, Polynesia, and the West Indies.

* 2. **Sorghum Roxburghii**, Stapf in Fl. Trop. Afr. ix, 126.

Description: Annual. Culms stout, tall, often slightly waxy, pruinose below the nodes. Leaf-sheaths softly pubescent at the nodes; ligules very short, scarious, hairy from the back; blades linear to linear-lanceolate from a broad clasping base, long-attenuated upwards, up to over 45 cm. long and up to 37 mm. wide, usually hairy to tomentose inside above the ligule and outside at the junction with the sheath, otherwise glabrous. Panicle oblong to ovoid-oblong, rarely subovate or elliptic in outline, erect, contracted and dense (rarely lax) in flower, somewhat to much loosened when mature; branches slender, flexuous, whorled or semiverticillate, the longest undivided for up to 12-25 mm. (rarely much more) from the base, more or less ciliate towards the base and often villous at the junction with the nodes, otherwise like their divisions glabrous or nearly so, finely scabrid upwards. Racemes tough, up to 4- (rarely 5-) noded, 8-12 mm. long; joints slender, 2·3·3 mm. long, distinctly and often densely ciliate, cilia white or purplish; pedicels similar but more slender, of about the same length or more often shorter with very slightly thickened tips. Sessile spikelet ovate, acute, with a small fine point, sometimes flattened on the back when young but soon convex, about 5·3 mm. by 2·7-3·3 mm., permanently pale or dull straw-coloured to tawny, at length slightly glossy; callus-beard, white. Involucral glumes equal, coriaceous, lower about 10-13-nerved, finely and often obscurely 2-keeled towards the tips with the keels slightly scabrid, transversely constricted at the base, more or less white-strigillose (to almost tomentose) when young, at length more or less glabrescent on the back, upper 7-9-nerved, finely keeled upwards, tip usually straight. Floral glumes distinctly ciliate, cilia up to 1 mm. long, lower broad-oblong, as long as the glumes, upper broad-ovate, 3·3-4 mm. long, middle nerve much thickened from the middle upwards, running out into a short straight mucro, lobes adnate to it almost all along. Anthers 2·7 mm. long. Grains elliptic or ovate-elliptic in outline, 3·8-4·6 mm. by 2·7-3·3 mm., dull white (in the African specimens). Pedicelled spikelet usually neuter, linear or linear-lanceolate, up to 4·2 mm. long, more often much reduced and quite small, persistent; lower involucral glume, if well developed, up to 9-nerved, upper 5-nerved.

Of this species Stapf describes two varieties which also occur in India.

(*a*) Var. **semiclausum**, Stapf in Fl. Trop. Afr. ix. 127.—*Holcus Sorghum minus et Sinensis*, Wall. Cat. 8777 F. A.—*Andropogon Sorghum*, subsp. *nitidus*, var. *Roxburghii* (?) and *fulvus*, Hack. in Monogr. Androp. 510 and 512.—*A. Sorghum* var. *Usorum* (?). Stapf in Dyer Fl. Cap. vii, 348, *in nota*; Medley Wood, Natal Pl. ii. t. 120. *non* Koern. *neque* Hack.

Description: Panicles fairly dense, also when mature. Involucral glumes less coriaceous towards the tips and more or less showing the nerves in that portion, permanently more or less strigillose, their margins clasping the grain so that only its top or upper half is exposed.

Distribution: Nileland of tropical Africa, Mozambique District, Natal, Madagascar, India.

(*b*) Var. **hians**, Stapf l. c. 127.—*Holcus Sorghum nitidum*, Wall. Cat. 8777 D.—*Andropogon Sorghum*, var. *hians*, Stapf in Hook. f. Fl. B. I. vii, 184.—*A. Sorghum*.

var. *Roxburghii*, K. Schum. in Engl. Pfl. Ost. Afr. B, 48 ; C. t. iv, F-H ; Busse and Pilger in Engl. Jahrb. xxxii, 184, *partim*.

Description : Panicles more or less loose with very flexuous and often drooping branches. Involucral glumes coriaceous to the tips with the nerves quite obscure, subglabrous and somewhat glossy on the back when mature, their margins involute, exposing the whole grain, which is often placed with its back and front parallel to the median line of the spikelet.

Distribution : Mozambique District ; also in India.

* 3. **Sorghum bicolor,** Moench Meth. 207, var. **obovatum,** Stapf in Fl. Trop. Afr. ix, 127.—*S. bicolor*, Willd. Enum. Hort. Berol. 1036.—*S. nigrum*, Roem. & Schult. Syst. ii, 837.—*S. vulgare bicolor*, Pers. Syn. i, 101.—*S. vulgare*, var. *obovatum*, subvar. *nigrum*, Rendle in Cat. Afr. Pl. Welw. ii, 151.—*S. rubens*, Willd. Enum. Hort. Berol. 1036.—*Holcus bicolor*, Linn. Mant. Alt. 301.—*H. Sorghum*, Mieg. in Act. Helv. viii, 129, t. 4. f. 4.—*H. niger*, Ard. in Sagg. sc. e lett. acad. Padova, i, 134, t. 5.—*H. saccharatus*—Gaertn. Fruct. ii, 3, t. 80. fig. 2 (?), *non aliorum auctorum.—Andropogon niger*, Kunth. Enum. i, 501.—*A. rubens*, Kunth l. c. 502.—*A. Sorghum*, subsp. *sativus*, var. *obovatus*, Hack. in Monogr. Androp. 514.—*A. Sorghum*, var. *bicolor*, Koern. in Bull. Herb. Boiss. ii, 226.

Description : An annual. Culms stout, up to 4 m. high, many-noded. Leaf-sheaths mostly overlapping, finely pubescent at the nodes ; ligules short, ciliate from the back ; blades linear to lanceolate-linear from a broad and rounded or slightly narrowed base, up to 50 cm. long and 7·5 cm. broad, pubescent to tomentose inside above the ligules and less so or glabrous on the back at the junction with the sheath. Panicles erect, contracted and more or less dense, or loose and oblong or oblong-ellipsoid or obovate to oblanceolate in outline 7·5-30 cm. by 5–9 cm. ; branches erect or obliquely erect, rather rigid, finally sometimes slightly drooping, the longest often more than half the length of the panicle and undivided for 12 mm. to 7·5 cm. from the base, like the branchlets very rough, spinulously ciliolate or ciliate, particularly upwards, silghtly hairy, rarely villous at the base. Racemes tough, compact, frequently 3- or 4- (rarely 5-) noded ; joints somewhat stout, flattened, 1·6–2·7 mm. long, shortly whitish or fulvously ciliate ; pedicels similar, about 1 mm. long. Sessile spikelet more or less broadly obovate even in flower, with very short broad and depressed tips, 4·8-5·8 mm. by 3·3-4·2 mm., straw-coloured to tawny, finally darker, often with red or brown or purple spots or blotches or turning altogether fuscous, chestnut-brown or quite black, closed when mature or only slightly gaping, usually awned ; callus-beard scanty. Involucral glumes equal, firmly coriaceous except at the papery to membranous tips, unevenly strigillose particularly and mostly persistently on the tips or almost glabrous ; lower up to 16-nerved, nerves very faint, keels short, usually obscure, tips very short, broadly triangular with a hyaline point, depressed ; upper broad, 9-nerved, obscurely keeled close to the tip, otherwise broadly rounded on the back. Floral glumes ciliate, lower broad-elliptic, about 4·2 mm. long, upper broad-ovate, 3·3 mm. long, 2-lobed, awn about 10·6 mm. long, sometimes much reduced. Anthers up to 4·2 mm. long. Grain tightly enclosed in the glumes or the top slightly exposed, obovate-oblong in outline, 3·3–3·8 mm. by 2–2·4 mm., brown ; embryo-mark distinct ; nerves obliterated. Pedicelled spikelet neuter, persistent, lanceolate to linear-oblong, acute, about 4·2 mm. long, reddish ; lower involucral glume 9–10-, upper about 7-nerved.

Distribution : Lower Guinea. Occasionally cultivated in the Mediterranean region from Madeira to India, also introduced into Australia, the West Indies and Brazil.

* 4. **Sorghum Durra**, Stapf in Fl. Trop. Afr. ix, 129.—*Holcus Durra*, Forsk. Fl. Aeg.-Arab. 174.—*H. Duna* (sphalm.), Gmelin Syst. 173.—*Andropogon Sorghum*, var. *aegyptiacus*, Koern. in Aschers. & Schweinf. Ill. Fl. Egypte 164—*A. Sorghum*, subsp. *sativus*, var. *Durra* and *aegyptiacus*, Hack. in Monogr. Androp. 516. —*A. Sorghum*, subsp. *sativus*, var. *Durra*; Chiov. in Ann. Istit. Bot. Roma, viii, 24.—*A. Sorghum*, var. *niloticus* and *Schweinfurthianus*, Koern. in Aschers. & Schweinf. l.c. 778, 779.–*A. Sorghum*, var. *arabicus* and *rubrocernuus*, Koern. in Bull. Herb. Boiss. ii, App. ii, 12 (*probabiliter*.)

Description : An annual. Culms stout, up to 4 m. high and even more, 20–40-noded. Leaf-sheaths finely pubescent at the nodes ; ligules very short, shortly ciliate ; blades up to 40 cm. by 5 cm., quite glabrous (? always). Panicle usually quite compact, ovoid or ellipsoid, erect or sometimes recurved, 10–15 cm.

by 5–10 cm.; branches erect, more or less flexuous, rather slender, rough to spinulously ciliate, particularly upwards, ciliate to subvillous at the base, the longest up to one half or one-third the length of the panicle, divided from very low down. Racemes compact, tough, about 8·5 mm. long (in flower), mostly 3-or 4-noded; joints somewhat stout, flattened, 1 to almost 2 mm. long, whitish-ciliate; pedicels similar, but still shorter. Sessile spikelet rhombic-obovoid, subacute (in flower), greenish or straw-coloured with greenish tips, ultimately whitish or variously brown, dark red or black, awned or awnless, callus-beard scanty. Involucral glumes equal, coriaceous up to beyond $\frac{1}{2}$ or $\frac{2}{3}$, then papery, unevenly strigillose, particularly at the tips and sides; lower with a broad triangular greenish strongly nerved tip, about 12-nerved with 3 or 4 finer nerves interspersed, 2-keeled upwards (keels rough), more or less flattened out and very broad to rotundate when mature with the tips worn off and the back glossy; upper broad, 9-nerved with some additional finer nerves, slightly keeled upwards. Floral glumes ciliate; lower ovate-elliptic, over 4·2 mm. long; upper broad-ovate, 2-toothed, 4·2 mm. long, awn up to 7·5 mm. long, mostly much shorter and then hardly twisted and differentiated into column and bristle or quite suppressed. Anthers over 2 mm. long. Grain subglobose, slightly compressed, with a broad rounded much exposed top, white, yellow or variously reddish, 5·3 by 5·3 mm., nerveless, embryo-mark faint. Pedicelled spikelet neuter (? always), persistent; lanceolate to linear-oblong, subacute, up to 6·3 mm. long, greenish or reddish, lower 11-, upper 7-nerved.

Distribution : Nileland of Tropical Africa, Arabia, Afghanistan, India.

*5. **Sorghum papyrascens,** Stapf in Fl. Trop. Afr. ix, 134.

Only mature panicles were known to Stapf. Culms up to 12 mm. across at the base of the panicle. Panicle erect, oblong to oblanceolate in outline, contracted, dense, up to over 30 cm. by 10–13 cm.; branches more or less whorled, often many to a whorl, erect, the longer slightly arching, rather robust, like the branchlets rough to spinulously ciliolate upwards and softly ciliate or pubescent in addition, villous at the base or 12 mm. above it, following (longest) up to 15 cm. long and undivided for 5–7$\frac{1}{2}$ cm. from the base. Racemes tough, up to 4-noded and 18 mm. long, dense, much crowded; joints moderately slender, up to over 3·3 mm. long, shortly white-ciliate; pedicels similar, 1–2·7 mm. long. Sessile spikelet oblong (in flower), at length ovoid or oblong-ovoid, tight or somewhat inflated, closed, up to 9·5 mm. long, permanently pale straw-coloured or reddish; callus-beard very short. Involucral glumes equal, papery and transparent throughout; lower up to 16-nerved with numerous transverse veins, very obscurely keeled upwards or keelless, nerves raised from the base upwards, softly pubescent to almost villous, very imperfectly glabrescent or at length almost glabrous, hairs white; upper broad, about 13-nerved, very obscurely keeled upwards, much less hairy. Floral glumes conspicuously ciliate; lower broad-elliptic, 5·3 mm. long; upper broad-ovate, entire and awnless or shortly 2-lobed, with a mucro or an awn up to 6·3 (rarely 10·6) mm. long, usually slightly bent and hardly twisted. Lodicules densely ciliate. Grain completely enclosed by the glumes or partly exposed by their breaking up, obovate to orbicular-obovate in outline, compressed, biconvex, dull white or orange; embryo-mark faint, elliptic, slightly exceeding the middle of the grain. Pedicelled spikelet neuter, reduced to the involucral glumes, persistent, linear or linear-lanceolate, acute, pale straw-coloured or reddish, 6·3–8·5 mm. long, lower 11–13-, upper 9-nerved, shorter.

Distribution : Nileland of tropical Africa. Also known from India.

* 6. **Sorghum cernuum,** Host. Gram. Austr. iv, t. 3; Reichb. Ic. Fl. Germ. (1845.) t. 80, fig. 466; Stapf in Fl. Trop. Afr. ix, 136.—*Holcus Sorghum,* Linn. Sp. Pl. ed. 1, 1047 (*partim*); Mant. ii, 500.—*H. Dora,* Mieg. in Act. Helv. viii (1777), 125, t. 4, fig. 3.—*H. cernuus,* Ard. in Saggi sc. e lett. Acad. Padova i, 128, t. iii, fig. 1 and 2.—*H. compactus,* Lam. Encycl. iii, 140.—*Andropogon compactus,* Brot. Fl. Lus. i, 88.—*A. cernuus,* Roxb. Fl. Ind. i, 273.—*A. Sorghum* var. *cernuus,* Koern. in Koern. & Wern. Handb. Getreideb. i, 314.—*A. Sorghum* subsp. *sativus,* var. *cernuus,* Hack. in Monogr. Androp. 515.

Description : An annual. Culms stout, 3–4 m. high and more, 20–30-noded. Leaf-sheaths minutely pubescent at the nodes; ligules very short, densely ciliate from the back; blades linear-lanceolate, over 30 cm. by 6 cm., pale green, pubescent to tomentose inside above the ligule and outside at the junction with the sheath. Panicle erect or recurved, ovoid to oblong, very compact or

somewhat loose, 10–25 cm. by 5–7·5 cm.; branches rather stout below, rigid, spinulously ciliolate, particularly upwards, softly ciliate to villous at the base, branches divided almost from the base, the longest 5–7·5 cm. long. Racemes compact : up to 3- or 4-noded, up to 10·6 (rarely 12·7) mm. long; joints stout, compressed, 1 mm. long, more or less white-silky-villous ; pedicels very similar, of about the same length. Sessile spikelet ovate with rather broad tips, 5·3 mm. by 3·3–3·8 mm., pale straw-coloured with greenish tips, whitish when mature, awned. Involucral glumes equal, coriaceous about up to the middle or at the base only, otherwise papery and often partly spongy, white-silky-villous all over or glabrous on the coriaceous portion of the back ; lower 12-nerved (with the nerves distinct upwards and sometimes with a few very delicate additional nerves interspersed), sharply 2-keeled upwards with the keels spinulously ciliolate and abruptly ending, forming minute teeth between which the hyaline end of the tip protrudes ; upper very broad, about 12-nerved, slightly keeled upwards. Floral glumes very densely ciliate ; lower broad-ovate, 2-lobed, 4·2 mm. long ; upper broad elliptic-oblong, awn about 8·5 mm. long with the bristle half the length of the long-exserted column or more or less reduced. Anthers 3·3 mm. long. Grain equalling the glumes or more or less exserted, orbicular or orbicular-obovate in outline, more or less compressed, 4·2–5·3 mm. by 4·2 mm., white, dull ; embryo-mark indistinct. Pedicelled spikelet neuter, linear-lanceolate, 4·2 mm. long, pubescent, lower involucral glume 11-, upper 10-nerved.

Distribution : Upper Guinea, North Central Tropical Africa, N. Africa, the Orient to Turkestan and N. India as far as Manipur.

(*To be continued*)

A SPORTING TRIP TO BRITISH SOMALILAND, 1926

BY

LIEUT. J. W. BORRADAILE

(With 6 plates)

A visitor to Somaliland, who is accustomed to shooting under Indian conditions, will find many differences and not the least among which is the non-existence of the 'block system'. If you are a resident of Aden, for the sum of Rs. 50 the whole country is open to you, while if you come from elsewhere the cost of a license is increased to Rs. 300.

In Somaliland you cover big distances and must be entirely self-contained as regards transport, provisions and water, once the main road which connects Berbera, Sheikh and Hargeisa is left behind, for it is possible to travel for many days without meeting a human being. Moreover there are only three serviceable rest houses in the country and these, including the new one at Berbera, are all situated on the main road. Shops are only to be found at Berbera, Sheikh, Burao and Hargeisa. On one occasion we sent a runner fifty miles for eggs and he returned with one!

Perhaps the greatest obstacle which the traveller has to face is the lack of water. The rainfall is more than sufficient, but as the soil is gravel all the water rapidly disappears and then can only be found at the regular water holes. Not only does this increase the caravan, but it limits the marches as a fresh water hole must be reached before the supply carried from the last one is finished.

The geography of Somaliland can be described broadly as follows:—From a coastal strip of desert the Golis and Asser Ranges rise step by step to a height of 5,000 ft. Thence the great waterless plateau, which is an eastern outcrop of the Abyssinian highland stretches inland, a waste of grasslands and thorn bush.

It was on July 3, 1926 and with the sun already low above the distant mountains, that I first sighted Berbera. It was a remarkable picture. An oasis of white houses and palm trees, around which the coastal desert appeared, deep gold against the blue and white of the sea.

It was already dark before we had taken all our possessions from the little Cowasjee steamer and been rowed ashore, so, as it was clearly impossible to continue the journey to Sheikh on that day, we occupied quarters in Berbera, which had kindly been set aside for us. A night in Berbera during the Kharif season is no joke and we hastened our preparations on the next day so as to be across the desert strip before this wind began to operate. From a local merchant we hired two ancient Ford busses into which we put our tents, bedding, cooking pots, water carriers, provisions,

servants and finally ourselves. Much to our surprise these machines ploughed through the heavy sand at a reasonable speed, until about five miles outside Berbera we struck the foothills and the metalled road.

The foothills were bare and burnt-up and only at the regular halting places was there any sign of life, human or animal. To this statement I make one exception and that, about half-way between Berbera and Sheikh. Here my companion B— drew my attention to a small herd of gazelle which resembled the Chinkara of India. We recognized them as being Pelzehm's Gazelle, the Lowland Dhero of Somaliland, which are different from their highland relations the Speke's Gazelle in that the latter have very definite black markings on their sides and also a baggy protrusion on the nose which they can inflate to a great size. They do not do this under the influence of fear and I believe the cause is entirely sexual. In all other respects both these animals are the counterparts of the Arabian Gazelle and the Chinkara of India. As we expected to meet other representatives of this species we did not get out to shoot, but afterwards we discovered that they only inhabit the lower foothills and we only once came across them again.

After three hours we sighted the main bluff of the Golis Range which rises 2,000 feet sheer above a level stretch in the foothills and is the final 'step' up to the great plateau above. The road climbed a re-entrant in this bluff and after many bends and curves had been negotiated we could at last see the white houses of the little settlement of Sheikh across an open grassy plain.

It was at Sheikh that we were to engage our caravan, which would have been a lengthy business had not a kind friend already done most of the work for us. According to our reckoning we required ten camels at one rupee per march and four annas when stationary. We afterwards discovered that we had over-estimated the provisions required and could have managed with at least one camel less. These camels had three men and one woman with them as drivers.

We then engaged our hunters. B— had a Somali called Aden and a Midgan Jama, who had worked together very successfully on many previous trips. Aden spoke a little English and made an excellent foreman to the whole outfit, while Jama the Midgan as well as being an excellent hunter could speak and understand English, Arabic and Urdu, which he had acquired from the Pathan orderlies of a former master, as well as his own language. In addition he was something of a handy man and was by far the most useful servant we had.

These Midgans belong to an outcast tribe, whom the Somalis will not recognize. They depend for their livelihood on the use of their hunting dogs and are probably unequalled in the world as animal trackers. It would be interesting to see one of them following an animal with a Bhil of India over ground which was strange to both. The only times I have seen Indians trying to track seriously were, in one case tiger tracks a few hours old, and in the other those of a wounded panther which had passed a few minutes



1. The 'Motor Road' across the Maritime Desert.

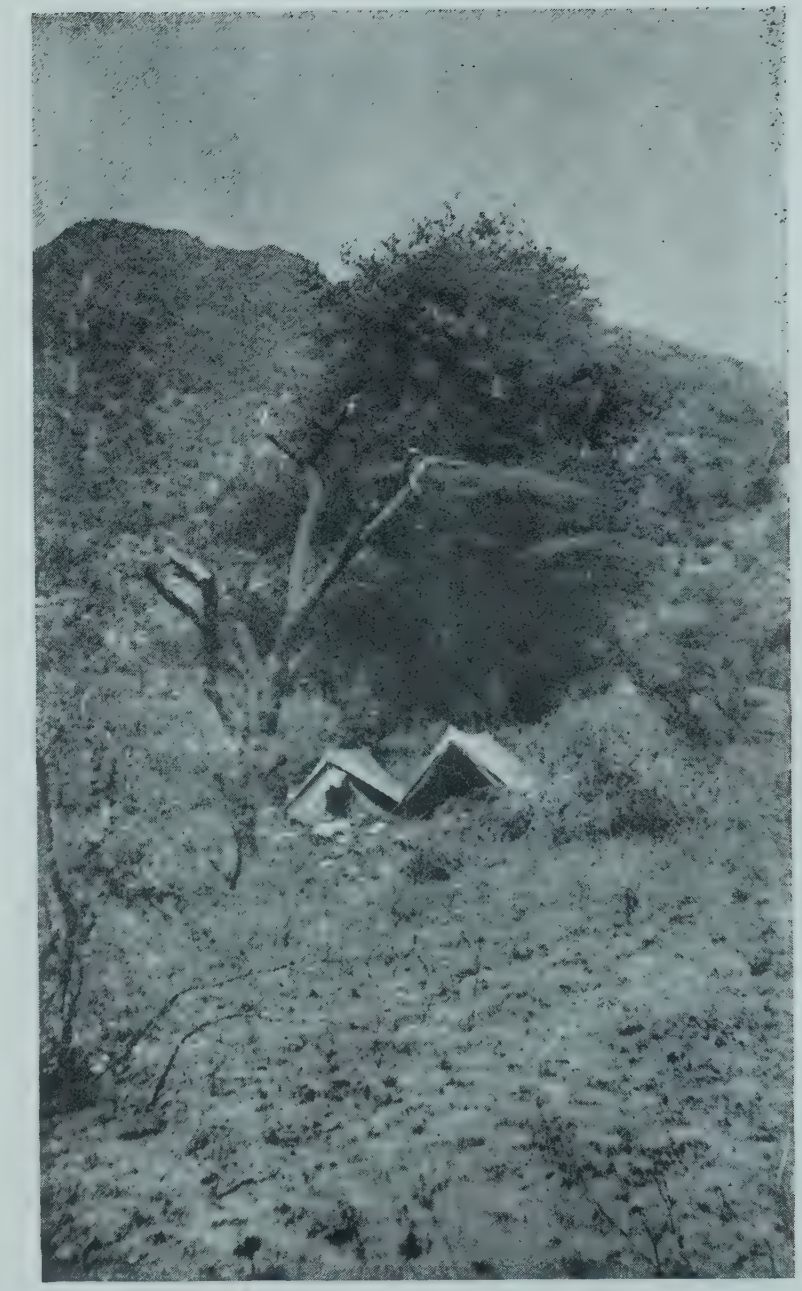


By courtesy. *Capt. Ross Hurst.*

2. Golis Scenery.



3. View from Hol-ka-boba Pass, Golis Range.



4. Camp at Gobedieh.

before them. On each occasion they were painfully slow and lost the tracks as soon as they left the river bed.

I had a Somali chief hunter named Chama, who had experience of hunting in Nairobi, Abyssinia and the Sudan as well as his own country. My second hunter could understand no known language though I tried him in English, Urdu and Arabic, nor was he particularly adept at understanding signs, otherwise he was a good worker.

Having settled these two important items, it now remained to collect a cook boy and two boys who would act as assistant bearers and the choice of these was left entirely with our own servants. I must say that I have never been so well served as I was by these Somalis. Each one was more than ready to exceed his proper work both while out hunting and in camp. So, the camel drivers were often used as assistant hunters and the hunters would always give a hand in the work of the camp, so that the speed attained in pitching and striking camp and preparing meals was prodigious. With the exception of the camel drivers all the Somalis were rationed by us at the daily rate of 1 lb. of dates, 1 lb. of rice, and $\frac{1}{4}$ lb. of ghee. Also, of course, they always got their share of meat when there was sufficient.

On the advice of friends who had shot in Somaliland before, we had already mapped out a route and this was based on the localities in which the various animals were to be found: elephant and rhino are not on the Somali license. Of the great cats, lion and leopard follow the flocks of the nomadic Somal and can only be located in the first place by the reports of anyone who is met with on the road and their discovery is a matter of some difficulty. In the case of leopard the chances of news are further limited, because being vermin, the natives are allowed to shoot them and they can sell the skins for a handsome price. Cheetah on the other hand, not being molester of cattle, must be left entirely to chance.

Somaliland has a great variety of antelopes of which the king is the Greater Kudu, who grazes on the rocky hills of the Golis Range and rarely comes into the open plain. His cousin the Lesser Kudu lives on the aloe bush which is found in the foothills just below the main Golis bluff. Hargeisa District has been closed to both these species owing to rinderpest and when this protection is removed the great hunting ground for Kudu will be the Asser and not the Golis Range. The little antelopes, Klipspringer and Beira inhabit much the same country as the Greater Kudu. The Beira favours particularly some very stony flat-topped hills in the Asser Range.

Upland Dhero (Speke's Gazelle) and Aoul (Soemmering's Gazelle) inhabit the open grassy places of the plateau and are often found grazing together, while Lowland Dhero live entirely in the foothills. Gerenuk (Waller's Gazelle) are to be found in almost any bush country and are particularly addicted to country intersected by small hollows and nullahs. The largest heads belong to the foothills, the upland variety being shorter and thicker. Oryx and Swayne's Hartebeest inhabit the open stretches towards the Abyssinian border, though Hartebeest are now rare except in

special localities. The Dib-a-Tag, a very rare beast lives in the surrounding bush and tall grass country, where also single male Oryx are found.

Finally the Dik-Dik, the smallest of antelopes are common to all bush country. Birds and hares and other exclusively 'pot' game keep to the neighbourhood of water and can usually be got within easy reach of camp.

Taking all this into consideration our plan was to travel along the top of the Golis as far as Hargeisa, picking up anything we could on the way. From Hargeisa we were to make a short journey into the waterless country of the plateau for Oryx and Hartebeest and then back along the foot of the Golis bluff for Greater and Lesser Kudu. Here also was the most likely country for lion and leopard.

The first march along the Golis was a short one in order to allow the caravan to settle down and except that we heard the sharp dog-like bark of baboons, the whole country seemed lifeless. We camped that night away from water eight miles outside Sheikh. We were off early in the morning and were at the watering place of Halo by midday, having collected one Klipspringer on the way. The Klipspringer is a pretty little beast standing about two feet at the shoulder with short straight horns and a very bristly coat. The Somalis call him Allacout and as we knew him only by his Dutch name there was some discussion before we identified him.

In this way we proceeded to the village of Adadleh, half-way between Sheikh and Hargeisa. A start was usually made at six in the morning and after the next meeting place with the caravan had been arranged, wet set out in different directions in search of game, usually taking the caravan route as a dividing line. From the stony hills around Halo we crossed the open plain and after this we struck the belt of bush round Adadleh, which we reached on the fifth day, having only collected the Klipspringer and three Dhero on the way. The country was uninhabited and we struck no encampments though we passed two or three caravans on the move, one of which gave us a false alarm of leopard which delayed us two hours.

This was my first experience of the African bush and I was struck immediately by the far greater variety of colouring and species than is seen in the Indian jungle. This was particularly noticeable in the case of birds and insects. Here were parrots, weaver birds, the great black and white horn-bill, the Kurria Plover with his white body and long red legs and painted starlings of every variety. One little fellow who reminded us of the Indian Myna was always round the camp. He had a gold breast and his wings were blue.

The Somalis have an ingenious scheme for catching birds alive. A succulent piece of corn is used as a bait and round this is concealed in the grass a wide slip knot. The bird descends and scratches for the corn, so tightening the knot round his leg.

There are three Somali insects, the memory of which will always be with me. The first are the huge centipedes which gave me many alarms until I was assured that they were harmless. The

second are the ants which disfigure the landscape with their building operations, many of their houses standing ten feet above the ground. The third are the ticks which cling to the legs, above the puttees and a number of which must be removed after every march. Fortunately we were not visited by the hard tick who is a carrier of relapsing fever. In addition there were insects of every kind and colour.

At Adadlah, Gerenuk were plentiful but shy, and we spent the next two days chasing this giraffe-like beast, which with its ungainly trot, absurd neck and the forward curve of the horns, is absolutely unlike any of the other Somali antelopes. I had come to the end of an unsuccessful chase after a Gerenuk and it was almost dark, when I saw for the first time a striped hyena. In the failing light he looked such an imposing beast that I would have shot at him had not he had the luck to walk behind a tree and then, alarmed by our presence, glide silently away. It was at Adadleh too that B— had our only experience of Aardwolf (*Proteles cristatus,* Sparrm.) The name 'Earth Wolf' is deceptive as this animal is no wolf at all. He lives underground, is of a reddish-brown colour and stands about 18″ from the ground.

Before leaving Adadleh, we made two additions to the caravan. The first was one, Hasan, nicknamed the Waraba (Hyena) a waster and the ugliest man I have ever seen. He remained with us for the rest of the journey doing odd jobs for his keep and contented to receive no pay. He afterwards proved quite useful to us. The second addition was yet another baggage camel upon which I rode the rest of the way to Hargeisa as I had a slight sprain in the ankle. I was not sorry to say good-bye to this beast, for sitting on his back propped up by two tents for a mile was infinitely worse than walking two.

Beyond the bush country of Adadleh was the Goriale Plain, across which it took us two days to march. Here we made our first acquaintance with Aoul (*Gazella soemmeringi*), a beast of about the size of an Indian Black-buck, though much more heavily built and very slow and clumsy in his movements. The horns of the Aoul curve inwards at the top and sometimes measure 20″. B— came back to camp with one on the first day and on the second I spied from the top of my camel a fat old Aoul grazing with two Dhero does. I dismounted and approached him at a somewhat deliberate pace and he watched me quite unmoved. When we afterwards measured his horns we found them to be 17½″.

On the same day B— brought back two Goli Warabas or Black-eared foxes. These beasts had always been something of a mystery to us. When my ankle had first given trouble at Adadleh, I had amused myself in the evenings by sitting up over a piece of meat at sundown in the hope of shooting one. I only succeeded in getting two jackals, which the Somalis call 'Fockus' and it was the mention of this name that had made me expect to see Black-eared fox. In the end I was told that Goli Warabas do not eat meat, which surprised me as they certainly have the head and teeth of the fox. Another peculiar thing we noticed about the Goli Waraba was that the plateau variety seem to be a different breed

to those in the foothills, and in spite of the hotter climate the latter have the heavier coats.

We were now in bush country again near the watering place of Badalwanak. Our next march should have brought us to Hargeisa had we not been the victims of a most peculiar occurrence. It had been raining during the morning in the hills which flanked our route and we were proceeding cheerfully with the caravan under the perfect blue sky, when we noticed that the ground underfoot was becoming sodden and in a few minutes the country was changed from a hard sandy surface into a marsh. Of course the camels could not proceed so we had to spend the night on the nearest high ground. In the morning it was dry enough to march into Hargeisa which we reached before midday.

Hargeisa is the serai of the Abyssinian trading caravans. It has a small English population which at that time included the District Commissioner, the Medical Officer, the Police Officer and the Headquarters of one company of the Camel Corps. Here we spent two days in order to replenish stores and make preparations for the journey to the Seila Ban Plain. We were able to borrow six more water tanks which with the two we already carried gave us a total of one hundred and twenty gallons.

We cut down the number of our followers by two, but added one man with local knowledge who was to act as a guide, also I exchanged my camel for a country pony and though the necessity of taking him was a drain on our resources, these ponies can work on very little moisture and are far more manageable than a baggage camel. At Hargeisa I was given the opportunity of playing a game of polo on them. I ride 13 stone 4 lbs., but they can carry heavier men than I with the greatest ease and turn remarkably quickly.

The road to the Seila Ban Plain took us through thorn bush and fields of yellow and red orchids. On the first day we reached camp in a storm which, though unpleasant at the time, gave us three hours of rain and filled water holes which would ordinarily have been dry. This to some extent solved our water problem, as the pony could be led to water and the used tanks could be refilled. The Somalis are notoriously lavish with water and even when the strictest guard is kept over it will aways find a way to waste some, which, considering the conditions they have always had to face it is surprising.

We were out early on the second day in search of Oryx and after about an hour's walk I struck a large Somali Karria (encampment) where I waited while my hunters asked for news.

These encampments are completely surrounded by a fence of bushes called a Zareba and inside are similarly divided into pens for sheep and cattle, two or three main roads and a space of about four yards round the circumference into which the camels are led at night.

These can be erected in a very short time with the aid of short sticks crooked at one end and forked at the other.

The crook is used for pulling the bushes up and the fork for



5. A *Kurria* WATERING, ALLADIEH.



By courtesy *Capt. Ross Hurst.*

6. LESSER KUDU (*Strepsiceros imberbis* Bly.)



By courtesy *Capt. Ross Hurst.*

7. 'Aoul' or Soemmering's Gazelle (*Gazella soemmeringi*, Cretschm.)



8. Oryx (*Oryx beisa*, Rupp.)

pushing them into position. When the tribe leaves the neighbourhood the old camp is left standing and these are to be seen all over Somaliland.

At this encampment I had my first drink of camel's milk out of a wooden bowl. I found it creamy and most nourishing. I also photographed a Somali woman carrying a child slung in a cloth on her back. The Somalis both women and men are usually of good physique and are often remarkably handsome, of which fact they are well aware, for a vainer race it would be hard to imagine. They are clean, and at intervals of about a week the men wash their hair with a sort of yellow plaster. Their dress consists of a sheet and they generally go bareheaded. Nearly everyone met with on the road carries arms, either an antiquated rifle or a couple of spears or club with an Oryx-hide shield. They are great fighters and will always join in anyone's squabble if they think they can get a good fight out of it.

Soon after leaving the encampment which caused this diversion, we found fresh Oryx tracks and within an hour I had got a fine male Oryx. The Oryx stands about the same height as a bull, has massive shoulders, is grey in colour with very noticeable black markings on the face. His cumbrous bovine appearance gives one the impression of great strength and endurance while his horns are straight and business-like.

It was late in the afternoon before B— reached camp and he told me he had followed the same Oryx tracks as I, and that seeing our footmarks had changed his direction. After an uneventful morning he had decided to make for camp and when he had tramped steadily for some way he thought he recognized a water pool which he had seen before, he marked this with his stick. Within an hour he was back at the same pool again. It was a dull day so he did not have the sun to help him. However he struck out in what he thought to be the right direction and it was many hours before he found a wandering Somali who guided him back to camp without hesitating once on the way.

The Somali bush on a dull day is most dangerous as it is completely featureless, the field of view is rarely more than a hundred yards and above all it is waterless. There are many cases on record of novices being 'bushed', but that this should happen to two Somali hunters conducting an Englishman surprised us.

Our next march led us to the edge of the plain. We made our camp (round which we built a complete Zareba) some two miles inside the bush in order to get shelter from the Kharif wind and a very charming little camp it was too. Here above all other places we felt entirely cut off from the human race with nothing but the bush and plain with their wild inmates around us.

It was on this day that I crawled up behind a bush to within twenty yards of an Oryx who was taking his afternoon siesta. I was so startled by his magnificent appearance at this close range, that I quite forgot to shoot and I watched him scramble ponderously to his feet and away !

The story of my second Oryx is not creditable. I wounded the animal rather too far forward and in our anxiety not to lose

sight of him again, we followed him as fast as we could run. After a disgraceful fusilade I brought him down and then feeling in the pocket of my woollen waistcoat for more ammunition was horrified to discover that it had dropped out and my stupid second hunter, who was following, had not retrieved it, so there I was with a wounded Oryx on my hands and not a round of ammunition within five miles. After a fruitless search for the ammunition we went up to have a look at the Oryx. He was quite alive but could not move. At last we resorted to a desperate remedy, placing a log of wood between his horns we twisted them until his neck was in a suitable position for the *halal* and though we accomplished this in the end he gave the three of us all we could manage and I learnt my lesson never to carry all my ammunition in one pocket.

Perhaps the best day of all was the one spent on the plain itself. There with an uninterrupted field of view of something like twenty miles, we could see great herds of Aoul probably totalling over 3,000 grazing beside herds of Oryx and far away to the south was the thin black line of the bush country on the Abyssinian border. We were disappointed at the absence of Hartebeeste and though B— got to within 300 yards of a male Ostrich the wind was too high to fire at anything but a certainty. Directly he became aware of our presence he made off at a great speed, dodging from side to side and looking like a bush on stilts. Here too B— saw a baby Aoul being chased by a hunting dog. The dog, by good stalking had got up wind of him and the little Aoul only just reached his family in time.

Having shot our allowance just as the water was running short, we returned to Hargeisa. Oryx meat is a great delicacy for the Somalis and the total amount of meat brought back to camp during this week must have been 400 lbs., yet when we asked for Oryx meat again in Hargeisa we were told that the Sahibs had eaten it all!

On our second visit to Hargeisa we were given the privilege of attending the court and were struck by the number of trivial matters which were brought up. One man complained that his son aged fifteen had been stealing the milk, another that his brother had hit him over the head with a club. All this goes to show that the Somali prefers British arbitration to his own methods.

Somaliland being a Protectorate is governed by Somali law, not British. Somali law has the peculiarity that capital punishment does not exist. The penalty for manslaughter, whether accidental or not, is the presentation of one hundred camels from the tribe of the offender to the tribe of the victim. This queer survival of inter-tribal law would have meant that had I accidentally killed a hunter, I should have been fined one hundred camels or 3,000 rupees.

We were now in two minds whether to strike west from Hargeisa as far as the Abyssinian border in hope of getting Hartebeeste or reserve the whole of our remaining time for the Guban route, below the Golis bluff. Circumstances led us to take a middle course which we bitterly regretted. This course was to strike north-west from Hargeisa to a place called Ged-ka-Debkaleh,

where we had heard that there were leopard, and thence join the Guban route at the foot of the Asser Hills. At Ged-ka-Debkaleh we found a huge fig tree which covered our whole camp. Of course there were no leopard there, so having disposed of the last Gerenuk on our license, we had to content ourselves with shooting Dik-Dik and game birds for the pot.

These did not fail us and we collected quite a number of species including Quail, Ball-throated Francolin, Partridge and Lesser Bustard and though we saw Greater Bustard and Guinea Fowl the moment was never opportune for shooting them. The Dik-Dik is a tiny antelope not larger than a hare, but he has a beautiful soft coat which is much in demand for ladies' gloves.

We now had a march of over thirty miles across waterless country to reach Jalelo on the main Guban route and as we had no man who had been this way before, Hasan, the Waraba, was taken on the strength in the capacity of guide. The direction of Jalelo was nearly due east and on the first day he took us north. Luckily we found water and camped by it for the night. We were taking our usual evening walk in search of birds when we encountered a large male Wart Hog, who appeared to be eyeing us in an aggressive manner, in fact he even advanced towards us. We had only one shot gun between us and B— slipped a round of lethel into it and fired. The ball went over his head, and the Wart Hog turned and trotted slowly away keeping his tail erect and completely unconcerned. I afterwards shot one of these beasts who behaved in exactly the same way. I do not think they do this with any idea of attacking a man, but standing in no particular awe of him, as they are absolutely safe from the Somalis, they approach merely to satisfy their curiosity. They differ from the Indian boar in that their long tusks are the upper and not the lower ones. I could never imagine one of them attacking the line of beaters and horses unprovoked, as I have seen an Indian boar do and I think the country in which they are found would make it impossible to hunt them on horseback.

We started at 6 a.m. on the next day and Hasan, the Waraba, completely led us astray. He could march in no particular direction for any time and at last we had to take control and set a course by the sun and we did not reach Jalelo until seven in the evening.

This was the second time that our hunters had lost us and yet in country which they know they can guide you back to camp in the most infallible manner. I can only think that they do not guide themselves as we do by sense of direction and the position of the sun, but from long experience have learnt to remember features in the bush which escape us altogether.

After this march we decided to have a day of rest at Jalelo. In the evening it began to thunder and rain, so we had dinner in our tents. Presently we heard the roar of water outside and ran out to see by the flashes of lightning that the river bed was a raging torrent some 300 yards wide. It must have risen eight feet in a few minutes. Soon the water covered our feet, then coming in from another direction put out the fires and swept into the tents. Boots and boxes of provisions were floating about everywhere.

A trap of branches was quickly made, the tents were struck and everything was carried up the hill. Only one person remained quite unmoved during the whole proceeding and that was the cook boy, who, sitting on a slight eminence, continued to bake to-morrow's bread until the flood had subsided from around him.

The spate had not sufficiently subsided by the morning to allow us to move and it was not until the third morning after our arrival at Jalelo that we started our next march to Argan. After the spate the servants took the opportunity of asking for a rupee each 'to give to the Bishop at the coffee shop' as a thanksgiving for their deliverance. Needless to say this was not granted. The Somali coffee shop is not as its name signifies, a place where coffee may be bought, but it is usually a rickety house of branches near a water hole where those who come to draw water from the neighbouring Karrias, may sit down and exchange news.

We had not proceeded far on the Argan road before we saw leopard tracks in a river bed, so decided to camp the night by some water, which was nearby and in the meantime to send out men in all directions for news. We heard that the leopard had visited a Karria about three miles away and we reached this place before dark.

The Somali method of shooting leopard is to tie up a goat outside the Zareba at night with a rifle hole within two yards of him. The leopard attracted by his cries pounces on the goat right under the muzzle of the rifle. Only of course it is not nearly so simple as all that. For one thing the leopard are wily and will smell a rat if there is any flaw in the preparations, and for another thing the hyenas are a perfect plague and must be driven off silently by the hunter with a spear. Added to this, on a dark night, it is not easy to distinguish through a small hole with the eye, a rifle's length behind, which is a leopard and which a hyena. On this occasion the hyenas were particularly numerous and no leopard appeared and although we laid this trap several times during the return journey it was never successful.

Argan is an attractive spot. The banks of the river bed are covered with bullrushes and date bushes. Here I tried to photograph some baboons, but they seemed so annoyed at my intrusion that I took the exposure at too long a range and the result was unsatisfactory. Another peculiar little beast which we saw here was the Rock Rabbit. He appeared to be about the size of a rabbit without the long ears and this made his head seem very round.

At Argan we got rumours of lion and again sent our hunters out into the country for news. Hasan, the Waraba, returned to say that he had seen the tracks of a female and two cubs five days old at a pool some way up stream and we set out in this direction on the next morning. We soon found tracks of the previous evening and followed them through the most forbidding looking rocky outcrops of the hills. Unfortunately the lady had not killed during the night, so she did not lie up anywhere; at one point we saw the marks of her having attacked a Wart Hog. There had been a scuffle, but the Wart Hog had undoubtedly made



9. JUMA THE MIJIKAN WITH 'BEIRA' (*Dorcatragus*



10. 'GERENUK' OR WALLER'S GAZELLE (*Lithocranius*



11. The Golis Range



his escape. It was not until after dark that we reached camp to hear that a male lion had killed a camel five miles away in the opposite direction and that the news had come in too late to reach us.

The difference in the tactics used on the Somali lion and the Indian tiger are great. There is no question of sitting up in a machaan after dark as the lion rarely returns to his kill, though he is sometimes caught by the same trap as is used for leopard. In Somaliland also the only beaters available are drawn from your own personnel and rarely number more than five. Usually the lion is tracked to wherever he is sleeping off the effects of his feed and if the bush is thick you manœuvre to get down wind while the hunters fire the grass on the opposite side and he must be shot on foot as he emerges, there being no tree capable of holding a machaan.

The next morning we were out at the pool again, but saw no new tracks. Attracted by the gathering of vultures we visited a Karria to find that a camel had died from natural causes and that the Somalis were eating the flesh almost hot off the beast. Leaving this rather unpleasant scene, we crossed a col into another valley and here B— shot a Beira with a head of $4\frac{1}{2}''$. The Beira (*Dorcatragus melanotis*) is rather bigger than a Klipspringer. His French grey colour makes him very difficult to pick out on the hillside. His ears are huge and in proportion to his body and his feet are rounded at the bottom in a peculiar manner.

As our time was now getting short, we had to leave Argan behind us and start the next march to Mandera. At this place we had our first dealings with Lesser Kudu, which lives in the very thick bush just below the Golis bluff. Like the Beira he has huge ears and when disturbed bolts away at a great speed, making it very difficult to shoot him.

My two hunters were once following the tracks of a Lesser Kudu and I was walking behind them, when I suddenly saw the head and neck of the Lesser Kudu above a bush a few yards away. He was watching the movements of the hunters with the greatest interest and they had walked right past him. Directly he saw that he was detected he made off like a streak. Between Sheikh and Mandera we each got our allowance of Lesser Kudu, but not without many failures. He is a beautiful antelope with his spiral horns and striped body and is well worth the trouble and expenditure of shirts torn by the very thorny bush.

On the hills above Mandera I chased a fine Greater Kudu bull for eleven hours on one day and twelve on the next and only got three glimpses of him. On the last occasion I determined to fire at any reasonable range. I got one at 300 yards with a cross wind and only scratched him on the back of the leg and though I followed him all that day, I failed to come up with him again, but as he climbed three large hills, I hope he is alive to this day. The specimen I afterwards shot not far from Sheikh was not to be compared with this one.

On the way to Lower Sheikh we passed mica deposits in the hills and took seeds of various plants including sweet peas and

castor-oil plant. Our hunters collected honey. There we paid off our followers. The whole cost of two months was about Rs. 1,200 each and this included liberal tips. Most of the provisions which we took were unused and we only opened two tins of sausages during the whole period and that was when we were following lion at Argan. Our bag included one Great Kudu, four Lesser Kudu, one Beira, two Klipspringer, four Oryx, four Aoul, six Gerenuk, five Speke's Gazelle, one Pelzehm's Gazelle, fifteen Dik-Dik, one Wart Hog, three Black-eared Fox and with game birds and hares numbered about 112 head.

We were preparing for our departure at Berbera when we were surprised to see Hasan the Waraba whom we had left at Sheikh, the possessor of only a waist band and a talisman. He was now dressed in a brand new sheet, the ample folds of which covered his whole body and round his waist was tied a coloured cloth.

INDIAN DRAGONFLIES

BY

LT.-COL. F. C. FRASER, I.M.S., F.E.S.

Part XXVIII

(*With three plates.*)

(*Continued from page 889 of Vol. XXXI*)

Genus—RHINOCYPHA Ramb. *cont.*

Rhinocypha ignipennis, Selys, Bull. Acad. Belg. (2) xlvii. p. (1879) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 173, 179–181 (1904) ; Laid, Rec. Ind. Mus. p. 35, vol. xiii (1917) ; Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 22 mm. Hindwing 22 mm.

Head. Labium black ; labrum black, unmarked in adults, with two oval bluish spots in tenerals ; face glossy black, upper part of head velvety black with a small oval orange spot on the outer side of each posterior ocellus and a small rounded postocular spot on each side of occiput. At rear of latter, and midway between these two spots, a small linear orange spot.

Prothorax velvety black with a small median orange spot on the hinder part of median lobe and a long lateral spot of pale blue or yellowish on each side.

Thorax velvety black marked with orange as follows :—a tiny upper antehumeral spot, a fine linear posthumeral stripe broadly broken above, incomplete below, a short linear spot on the upper part of the first lateral suture, and an elongate oblique lateral orange stripe on the lower part of thorax, broadly broken in two by the anterior border of metepimeron.

Legs black, the hinder pairs of tibiae not pulverulent on the inner side as in most other species.

Wings semiopaque from node to apices, this area dark brown by transmitted light, brilliant fiery coppery by reflected light. The hinder pair with two rows of vitreous spots which vary in tint from mother-of-pearl to palest peach-blossom pink or pale blue. The most basal spot about 14 cells long, one cell-row wide, begins about six cells proximal to the node and ends distad about two to four postnodal cells beyond the node, lying between *MA* and *Riv* + *v*.

The outer row consisting of three long stripes similarly coloured, the costal one rather the longest of the three, the posterior slightly the shortest, the costal one lying between *IRii* and *Riii*, about 26 cells long ; the middle stripe between the same nervures as the basal spot, about 22 cells long, one cell wide proximad, three distad ; the hinder stripe 15 cells long, lying between *Cui*, and *MA*.

Pterostigma dark yellowish brown framed in black and with inner third the same colour. Inner hyaline areas of wings tinted with pale yellow ; 16 to 18 antenodal nervures ; discoidal cells traversed 3 to 4 times ; petiolation begins rather nearer the level of the proximal antenodal than the level of arc.

Abdomen black or steely blue, marked on the sides of the first two segments only, with a large orange spot on segment 1 and a tiny apical spot on segment 2. Teneral specimens are marked very nearly as in the female described below.

Anal appendages black, shaped as for *cuneata*.

Female. Abdomen 21 mm. Hindwing 28 mm.

Head black spotted with yellow or orange as follows :—The base of the labium and a spot on each lateral lobe, a broad oval spot on each side the base of labrum, the mandibles broadly, a large spot on each cheek and the basal joints of antennae, a tiny spot on each side of epistome, a large broadly oval transverse spot on each side of frons, with a smaller spot just behind each, a rounded spot on each side of the anterior ocellus and lastly the same spots as in the male

Prothorax black with bright yellow markings as follows :—A fine medial middorsal line running from the posterior lobe to anterior end, the marginal

crest of the posterior lobe and an inward prolongation from this, a very large bell-shaped spot on the sides of the middle lobe.

Thorax velvety black, marked as for the male but more broadly so, the oblique lateral stripe extending the whole length of thorax, and broken in three places by the lateral and humeral sutures.

The humeral spot linear and, after a short interval, continued as a fine stripe to anterior end of thorax; the posthumeral stripe complete. Beneath, two large orange spots at hinder area of thorax.

Legs black, the flexor surfaces of femora slightly but distinctly pulverulent.

The middorsal carina and midline of antealar sinus finely yellow.

Wings hyaline, palely enfumed greenish yellow. Pterostigma as for male; antenodal nervures about 20 in number.

Abdomen black marked with yellow or ochreous as follows :—Segment 1 with a large lateral spot, 2 to 4 with an apico-lateral spot and a linear spot nearly confluent with it, lengthening to a stripe on segments 3 and 4 ; lastly segments 5 and 6 with a vestigial apicolateral spot. Anal appendages and vulvar scale as for *cuneata*.

Distribution. Assam and Upper Burma. Mr. T. Bainbrigge Fletcher has found it quite common at Shillong, Assam during September to November. The Selysian type comes from this district, and is now in the Brussels Museum. The specimen described by Williamson from Burma is undoubtedly a teneral male of this species, and is the only record from Burma.

The species is quite easily distinguished from all others save *trimaculata* which has the same glorious colouring, but which is smaller and has the vitreous spots much shorter than in *ignipenuis*. *R. fulgipennis* from Siam has similarly coloured wiugs, but the wings are broader and the thorax bears a coloured mesothoracic triangle. The colouring of the wings of these three handsome insects reminds one strongly of the gorgeous fiery Indian sunsets and is unexampled in nature.

Rhinocypha trimaculata, Selys, Syn. Cal. p. 62 (1853) ; Id. Mon. Calop. p. 211 (1854) ; Laid. Rec. Ind. Mus., vol. xiii, p. 35 (1917) ; Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 18 mm. Hindwing 22 mm.

Head velvety black, labium and labrum unmarked, vertex and occiput marked as for *ignipennis*, viz.,—a reniform spot on the outer side of each hinder ocellus and a small round postocular spot behind each, with an elongate small spot between them on hinder border of occiput.

Prothorax velvety black, quite unmarked.

Thorax glossy black marked with bright yellow, bluish green or blue according to the age of specimen, as follows :—A tiny upper humeral spot, a fine linear posthumeral stripe, broken above, a short fine line on upper part of first lateral suture, an irregular oblique stripe running the full length of side of thorax, broken into three spots, one of which occupies the central part of metepimeron, and another, more elongate, the centre of mesepimeron.

Legs black, not pulvurulent as to the tibiae.

Wings fiery coppery red, even more brilliant than in *ignipennis*, semiopaque from level of node in hindwings, from slightly distad of that level in the fore where the costal margin of wing is hyaline as far as beyond the pterostigma. In the hindwing four vitreous spots of the palest iridescent blue or peach-blossom pink, the palest one of which is about 17 cells long, extends from distal end of discoidal call to the level of the 3rd postnodal cell, and lies between *MA* and *Riv* + *v*. The outer spots consist of a series of three, all of about the same length, the costal one lying between *IRii* and *Riii* and about 13 cells long, the medial and hinder spots each 10 cells long, the latter lying between *Cuii* and *MA*.

Pterostigma blackish brown, clouded with white in its outer half in subadults. Antenodal nervures 15 to 17 in number; discoidal cell traversed 2 or 3 times.

Abdomen glossy black with a lateral spical spot on segments 1 and 2.

Anal appendages black, shaped as for genus.

Female. Abdomen 17 mm. Hindwing 23 mm.

Head velvety black marked with pale yellow as follows :—The base of labium, which has a greenish tinge, a pair of small basal spots on labrum, the bases of mandibles broadly, large darker yellow spot on upper surface of rhinarium and two large cuneiform spots just behind it. The basal segments of antennae, a

rounded spot in front and on either side of the anterior ocellus, a small spot on either side of rhinarium and finally the same spots as seen in the male.

Prothorax black with a large yellow spot on each side of midlobe, a short medial dorsal line on the posterior lobe and a large spot on each side, low down near the trochanters.

Thorax black marked with yellow as follows :—Similar but larger spots as seen in the male, often with a greenish tinge, and probably bluish during life. In addition, a long linear streak on lower half of humeral region. Beneath thorax two broad longitudinal streaks of greenish yellow. Legs, black, non-pruinescent.

Wings deeply enfumed, burnt brown, especially the hinder and towards the apices. Pterostigma black, white in its outer half ; 12 antenodal nervures ; discoidal cells traversed twice in all wings.

Abdomen black marked with blue, the first seven segments with a lateral apical spot, the 2nd to 5th with a lateral stripe in line with but not confluent with the apical spots.

Anal appendages and vulvar scale black, shaped as for the genus.

Distribution. The Selysian types, two males, are reported as from Thibet. The species, discovered in 1853, was not found again until Mr. Antrim took it in numbers at Cachar, Assam in September 1921. It must be a remarkably local insect or such a handsome, and brilliant insect would have been taken many times in the intervening 68 years. If possible, its brilliancy outshines its near relation *ignipennis*, from which it is distinguished by its smaller size and the vitreous spots of hindwing much shorter. The female, hitherto, unknown, and described here for the first time, is also distinguished by its smaller size and by its blue markings, etc.

Paratypes have been placed in the British Museum.

Rhinocypha unimaculata, Selys. Syn. Cal. p. 61 (1853) ; Id. Mon. Cal. p. 207 (1854) ; Walk., (*Libellago unimaculata*) List. Neur. Ins. B. M. iv. p. 649, n. 12 (1853) ; Laid. Rec. Ind. Mus., vol. xiii, p. 35 (1917) ; Kirby, Cat. Odon. p. 113 (1890).

Male. Abdomen 24 mm. Hindwing 27–30 mm.

Head velvety black, the labium and labrum unmarked, rounded spots of chrone yellow on each side of occiput, one on the outer side of each hinder ocellus and a central spot on posterior border of occiput.

Prothorax black with a large irregular yellow spot on each side of middle lobe, a small linear middorsal spot on the posterior lobe and a narrow yellow margin to the same lobe laterally.

Thorax glossy black marked with bright yellow lines as follows :—A short oblique linear upper humeral spot, a long antehumeral line, incomplete above, markedly angulate below, a fine posthumeral line broken above, a short upper line on the first lateral suture and finally the same broad broken oblique stripe on lower part of sides of thorax as seen in *ignipennis* and *trimaculata*. The middorsal carina is usually finely mapped out in yellow, and this may be continued on to the antealar sinus.

Legs black, the two hinder pairs of femora and tibiæ densely pruinosed white with a creamy yellow tinge.

Wings enfumed brown from slightly distad the level of node in forewings, and slightly proximad the same level in the hind, where this area is prolonged as a diffuse tongue in the space between *IRiii* and *Riv* + *v*. This area is also considerably darker in the hindwings, and in both pairs, is of a similar brilliant fiery coppery red as seen in *ignipennis* and *trimaculata*. In the hindwings, the middle of this coppery area bears a large roughly quadrate vitreous spot which glows emerald green or peacock blue according to the angle from which viewed. Its inner border is markedly indented, its outer roughly convex, its costal border is bounded by *Rii*, its posterior almost reaches the wing margin. The spot lies considerably nearer the node than pterostigma. Bases of wings hyaline, palely tinted with yellow. Pterostigma blackish brown, the outer halves paler. The apices of wings very finely reticulated, especially between the costa and *Ri*. Discoidal cells traversed from 5 to 7 times ; 21 to 23 antenodal nervures.

Abdomen black marked with yellow as follows :—The first 6 segments with a ventral stripe running nearly the full length of segments, segments 1 to 3 with an apical lateral spot, the intersegmental nodes narrowly yellow.

Anal appendages black, relatively short, shaped as for genus.

Female. Abdomen 22 mm. Hindwing 31–32 mm.

Markings of body very similar to those of male but more extensive.

Head with the same spots as in the male, with the addition of the following :— The lateral lobes of the labium, two obscure basal spots on labrum, the bases of mandibles broadly, this colour here confluent with a stripe which runs up the cheeks adjacent to and bordering the eyes, also extending on to basal joints of antennæ, and confluent with two large cuneiform spots on upper surface of rhinarium. On the latter, in front above, a large rounded spot ; a round spot on each side of and in front of the anterior ocellus, two tiny points between the posterior ocelli and a spot on the lower part of the sides of rhinarium. The postocular spots are much larger than in the male, and are nearly united by a transverse spot on hinder border of occiput.

Prothorax black marked similarly to the male but the middorsal stripe runs nearly the whole length of dorsum from hinder border of posterior lobe, and the lateral markings are much better defined.

Thorax glossy black marked as in the male but considerably more extensive. The antehumeral line continued up and curved outwards above to become confluent with the humeral oblique spot. Six small spots beneath thorax. Legs black, the hind two pairs of femora and tibiæ pruinosed yellow as in the male.

Abdomen glossy black marked with two parallel stripes of yellow, one ventral as in the male, extending from segment 1 to 7, the other on the same segments becoming broken up into a stripe and an apical spot on segments 4 to 7. Anal appendages and vulvar scale as for genus. The middorsal carina finely yellow from segment 2 to 7.

Distribution. The species seems to be centred about Darjeeling and is colonized in several districts in northern Bengal and Assam. The type is in the Selysian collection at Brussels, without locality save 'India.' It is the largest species of the genus and distinguished very readily by its peculiarly striking combination of markings and colours. By the absence of the mesothoracic triangle and the coppery colours of the wings it is closely related to the two foregoing species. A fusion of the middle series of vitreous spots has resulted in the large median spot, thus in one of my own specimens, the spot is practically cut in two by an invasion of the dark area above. I have taken this species in May and June, perching on rocks in midstream at Mongpoo, 3600 ft. British Sikhim.

Rhinocypha bifasciata, Selys, Bull. Acad. Belg. (2) xlviii, p. 386 (1879) ; Laid. Rec. Ind. Mus., vol. xiii, p. 34 (1897) ; Kirby. Cat. Odon. p. 113 (1890).

Male. Abdomen 22 mm. Hindwing 25 mm.

Head glossy black in front, velvety black above, labium and labrum unmarked, a large oval spot on the outer side of each posterior ocellus and a small round postocular spot on each side of the occiput.

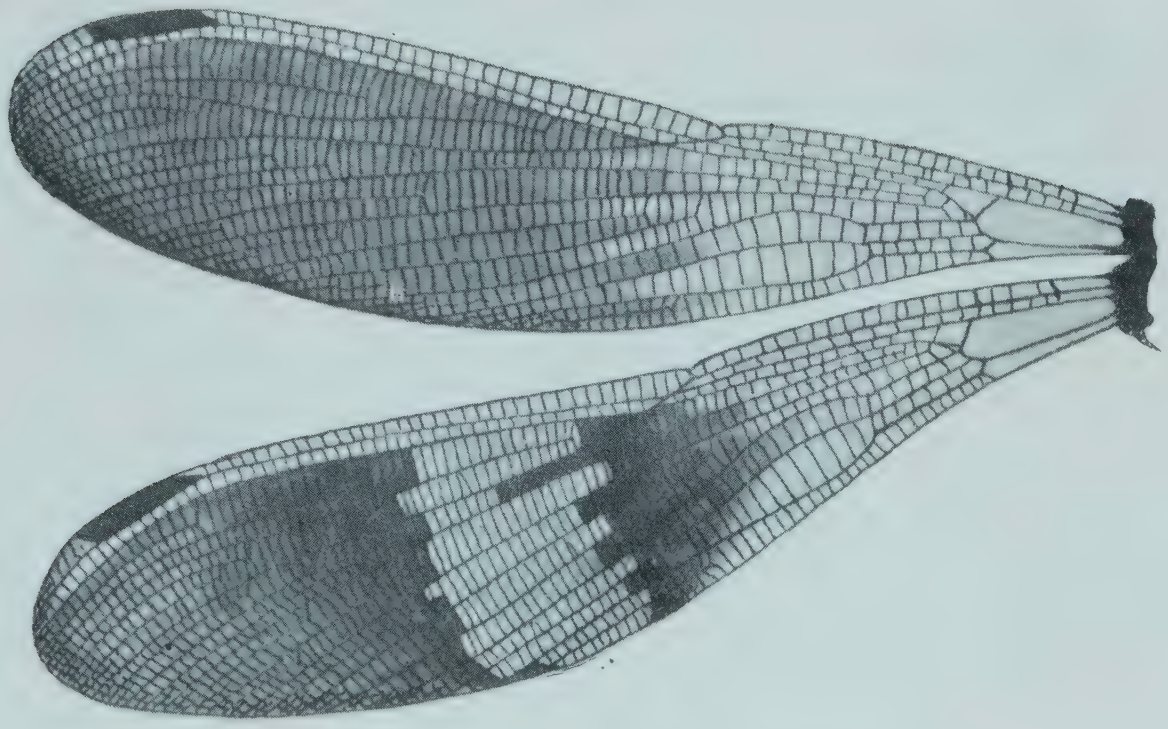
Prothorax black with a middorsal longitudinal spot on the posterior lobe.

Legs black, the two hinder pairs of femora and tibiæ heavily pruinosed white, this snow-like excrescense overlapping the margins of tibiæ and making them appear to be dilated.

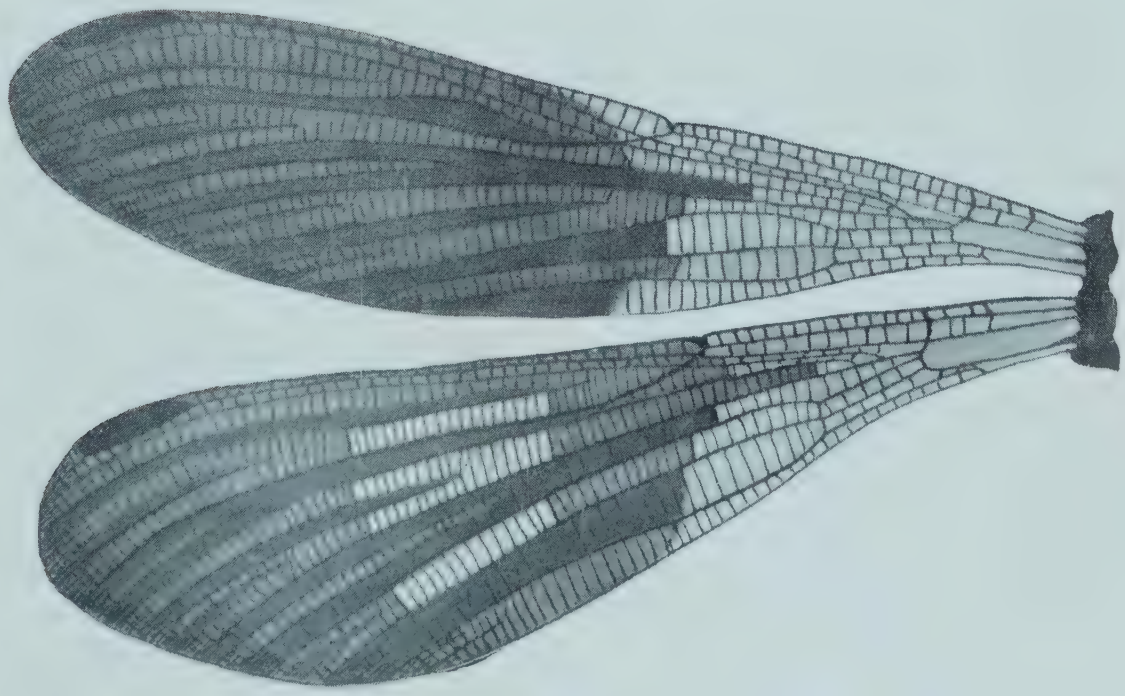
Thorax glossy black marked on the sides with a broad broken yellow band made up of a small serrate spot on the metepimeron, an elongate pyriform spot on the mesepimeron capped by a U-shaped spot anteriorly. The mesothoracic triangle very large, extending from alar sinus to anterior border of thorax, palest azure blue in colour.

Wings partially hyaline, greyish from discoidal cell to apex by transmitted light, palely yellow at the base. The darkened area by reflected light a beautiful violety blue or emerald green according to the angle from which viewed. The wings in this area have a satiny gloss and the hind are traversed by two brown bands from costa to hinder border, one at the apex of hind wings and the other a short distance to the inner side of pterostigma. Both bands very narrow and the inner very irregular and diverse in shape. The iridescent area limited anteriorly by *Rii*. Discoidal cells traversed 5 times ; 15 to 18 antenodal nervures. Pterostigma black, white or yellowish outwardly.

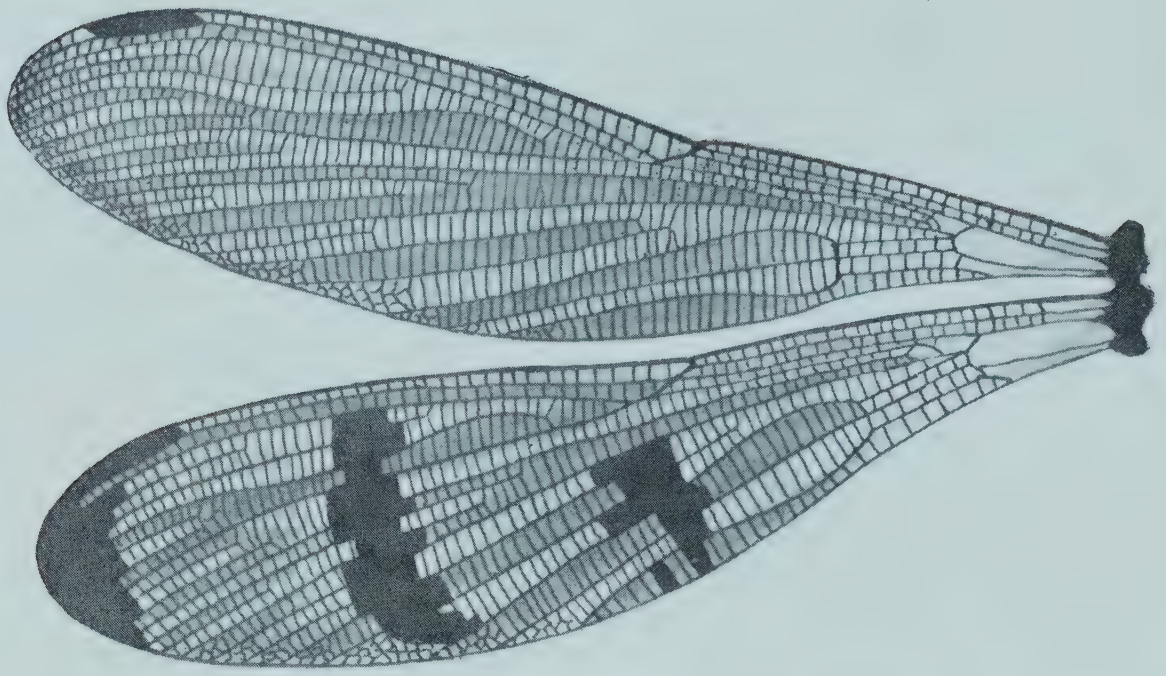
Abdomen glossy black with a small apical spot of yellow on the sides of segments 1 and 2. Anal appendages black and similar in shape to those of *cuneata*.



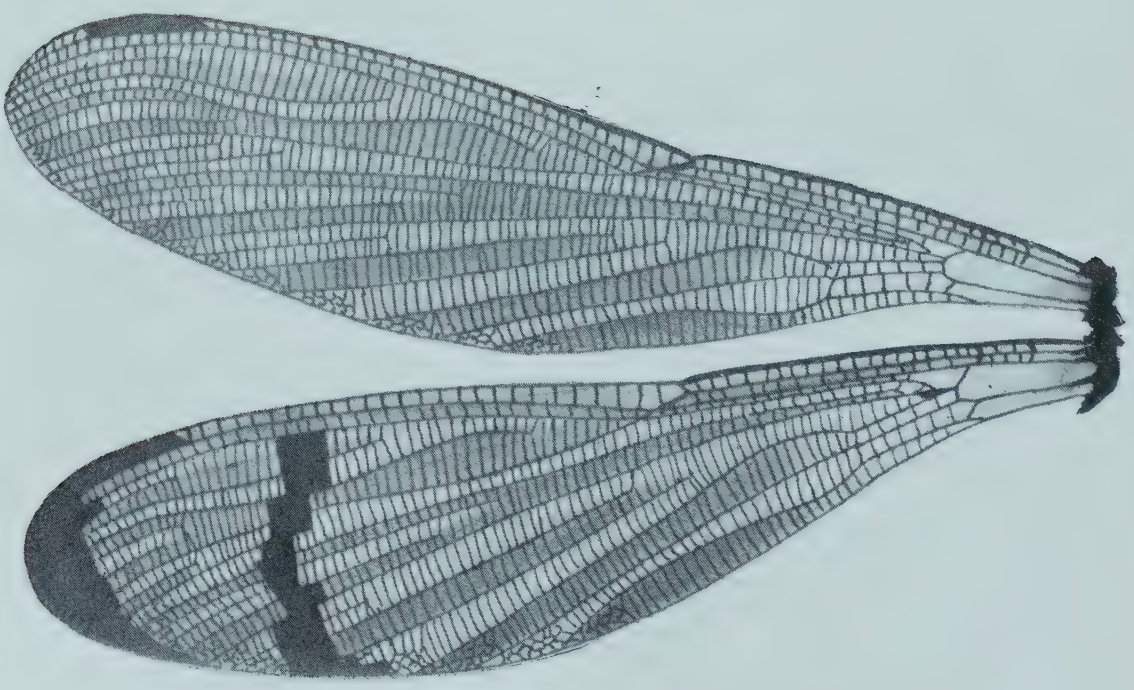
1. WINGS OF *Rhinocypha unimaculata*, SELYS., MALE.



2. WINGS OF *Rhinocypha trimaculata*, SELYS., MALE.



1. WINGS OF *Rhinocypha trifasciata*, SELYS., MALE.



2. WINGS OF *Rhinocypha bifasciata*, SELYS., MALE.

Female. Abdomen 18 mm. Hindwing 28 mm.

Head similar to the male but a medial spot on hinder border of occiput and a moderately sized, bright yellow spot on each cheek near the eyes continued up as a very narrow streak against the eyes.

Prothorax with an additional large spot just below the posterior lobe. Thorax with the mesothoracic triangle present, yellow in its upper half, this colour continued narrowly along both sides of the triangle below. The lateral markings are broader than in the male, and there are some additional markings as follows :—An upper antehumeral spot and a lower stripe, widely separated, a fine posthumeral stripe broadly interrupted above where it lives a tiny upper point, and not extending downwards as far as anterior border of thorax. There is also a fine broken line on the first lateral suture and a small spot on upper part of mesepimeron.

Wings evenly and palely enfumed throughout, with a pale greenish tint. Pterostigma black, its outer half or two-thirds yellowish. Discoidal cells with 3 to 5 traversing nervures ; 15 to 18 antenodal nervures.

Abdomen black marked with ochreous as follows :—A large lateral spot on segment 1, an apical spot and a basal stripe on segments 2 to 4, segment 5 with a small basal spot only, whilst segments 2 and 3 have a vestigial ventral stripe also.

Anal appendages and vulvar scale similar to the genus.

Distribution. Bengal—and Assam, more especially the latter. The type in the Selysian collection, in the Brussels Museum, is from Darjeeling. I have seen several specimens taken at Gopaldhara by Mr. H. Stevens during October and November.

There is no difficulty in distinguishing this beautiful species, the two opaque bands at once determine it, *hilaryæ* having the inner band much nearer the pterostigma, and the vitreous area limited to the outer apical area of wing.

The wings of this species and *trifasciata* are markedly pleated and if held in certain positions, one set of pleats glows with a satin-like violety blue sheen, whilst the other set shines emerald green. The restricted markings of the head will distinguish the female from other Indian species.

Rhinocypha trifasciata, Selys, Syn. Cal. p. 61 (1853) ; Id. Mon. Cal., p. 207, (1854) ; Walk. (*Libellago-trifasciata*) List. Neur. Ins. B. M. iv. p. 650, n. 13 (1853) ; Kirby, Cat. Odon., p. 113 (1890) ; Laid. Rec. Ind. Mus., vol. xiii, p. 34 (1917).

Male. Abdomen 24 mm. Hindwing 27 mm.

This species is very similar to the last, but is invariably larger, and the male bears an additional opaque band on the hindwings.

The head markings exactly similar to those of *bifasciata*.

Prothorox black with a middorsal longitudinal spot on the posterior lobe bluish in colour.

Thorax black marked very similarly to that of *bifasciata*, the mesothoracic triangle very large, extending from the alar sinus to the anterior border of thorax, pale blue in colour. A fine yellow line on the first lateral suture, broken above, a shorter line on the second lateral suture, incomplete below, a small spot below the root of the forewing. and the usual irregular broken stripe along the lower part of sides of thorax. This consists of a smallish spot on the metepimeron, triangular in shape, an elongate spot on the mesopimeron, with a cuneiform angulate spot at its anterior part.

Wings similarly coloured to those of *bifasciata*, the vitreous area of equal extent and bluish violaceous or emerald green according to the angle from which viewed. Three blackish brown bands traverse the hindwings from costa to posterior border. An apical band extending in to outer end of pterostigma, its inner border concave ; a medial band situate at about the junction of outer and middle thirds of wing, with serrate concave inner border, slightly sinuous convex outer, from 6 to 8 cells wide. An inner band with its inner border in line with or slightly distad of level of node, limited costalwards by *Riii*, reaching the hinder border of wing, moderately straight on its proximal border, with three outer prolongations on its distal border.

Pterostigma blackish brown, the central part, of that of hinder wings, paler ; 20 to 22 antenodal nervures ; discoidal cells traversed 6 times.

Abdomen black marked on segments 1 to 3 with a small apico-lateral spot of yellow. Anal appendages black, shaped as for genus.

Legs black, the two hinder pairs of femora and tibiæ heavily pruinosed white.

Female. Abdomen 22 mm. Hindwing 29 mm.

Very similar to that of *bifasciata* but considerably larger. The mesothoracic triangle long and broad as in the male, dark ochreous in colour. Markings of head, thorax and abdomen exactly as in *bifasciata*, with the exception of the mesothoracic triangle which is as described above.

Distribution. The type in the Selysian collection, in the Brussels Museum, is labelled ' India,' without further indication of its origin. Three males in the Indian Museum, Calcutta, are from Kailana, N. W. Provinces so that it would appear that this species has a more northerly and westerly distribution to that of *bifasciata*. The two species are undoubtedly distinct, although closely related. The opaque bands of hindwings are subject to considerable variation in shape and length. That depicted on Plate II shows an abbreviation of the stripes, whilst the description given above is from a specimen in my own collection.

Rhinocypha bifenestrata, Fras. Mem. Dept, Agric. Ind. Ent. Series, vol. vii, No. 7, p. 63 (1922).

Male. Abdomen 25 mm. Hindwing 27 mm.

Head black, labium and labrum unmarked. A small oval yellow spot on the outer side of each hinder ocellus, and a smaller rounded spot on each side of occiput.

Prothorax black, unmarked.

Thorax black marked with yellow as follows :—A vestigial broken posthumeral line, incomplete below, a narrow stripe bordering along the front of second lateral suture and a small spot below the hindwing. Mesothoracic triangle extending from the alar sinus to the anterior border of thorax, pale lilaceous in colour.

Legs black, the two hinder pairs of tibiæ only pruinosed white.

Wings largely opaque by fusion of three broad bands which enclose two large vitreous spots. Base of wings as far as outer end of discoidal cell hyaline, rather brightly saffronated. The opaque area in the forewings variable, usually broadly serrated and limited posteriorly by *IRiii*, but sometimes more closely serrated and extending as far back as *MA* at the base and *IRiv* nearer the apex of wing. The hyaline area posterior to the opaque area vitreous and a beautiful violet by reflected light, extending basad at one point to proximad of the outer end of discoidal cell. In the hindwings the opaque area extends proximad as far as 3 or 4 cells proximad of the node near costal margin of wing, and from thence runs obliquely out to posterior border of wing, with a very irregular border. By a confluence of the three bands, two large vitreous spots, violaceous in colour, are enclosed, varying much in size and shape in individual specimens. In the type the outer two bands are not much wider than in *trifasciata*, being narrowly connected along the costal and hinder borders of wing, but in some specimens, the apical opaque band extends as far in as slightly proximad of inner end of pterostigma. The inner spot is usually partially bisected by a prolongation of the inner band, one cell wide, running posterior to *Riii*, and in some specimens, this prolongation actually fuses with the middle band, thus completely bisecting the inner vitreous spot. In the type, the middle and inner bands are only very narrowly confluent along both costal and hinder margins of wing, so that the inner spot is of large dimensions Pterostigma black, its outer three-fourths white, but clouded with light brown in forewings ; antenodal nervures 19 to 20 ; discoidal cells traversed 6 times.

Abdomen black, quite unmarked. Anal appendages black, shaped as for genus.

Female. Abdomen 21 mm. Hindwing 31 mm.

Head ; labium and labrum black ; rest of head velvety black marked with bright ochreous as follows :—A large spot at base of mandibles, a narrow streak against the eyes expanding on to the cheeks, a narrow longitudinal streak on lower part of epistome, a tiny point just in front and to the outer side of middle ocellus, and two linear spots on frons in front of latter, a large rounded spot on outer side of each outer ocellus and a similar postocular spot behind it, lastly a large triangular spot at the middle of hinder border or occiput These markings liable to some variation thus the spots on the frons may be very large and triangular, or they may be entirely absent, the occipital spot may be small and linear or large and crown-shaped.

Prothorax black marked with bright ochreous :—A middorsal longitudinal

streak running from posterior lobe on to middle lobe, a small spot on lower part of posterior lobe and a spot on each side of middle lobe which may be large and triangular or reduced to a mere point.

Thorax black marked with bright ochre as follows:—The mesothoracic triangle except for its lower part, the intersecting suture of the alar sinus, a very fine antehumeral stripe, often broken into a chain of tiny points and best defined in its lower part, a posthumeral stripe incomplete below, broadly broken in its upper part, a linear spot on upper part of mesopimeron and a fine incomplete line bordering the first lateral suture; finally a broad irregular broken stripe on lower part of sides of thorax and two small rounded spots beneath.

Legs black, tibiæ not pruinosed.

Wings uniformly enfumed brown; pterostigma black, slightly clouded in its outer part with yellow; discoidal cells traversed 4-5 times; petiolation short, from near the first antenodal nervure or between the first and second; 20-21 antenodal nervures, 32-34 postnodals.

Anal appendages and vulvar scale as for genus.

Abdomen black marked with bright ochre as follows:—A small cuneiform spot on each side of segment 1, a small apico-lateral spot followed by a short streak, and a ventral stripe on sides of segments 2 to 4, segments 5 and 6 similar but the upper streak obsolete and the apical spot much reduced.

Distribution. Moungpoo, British Sikhim, 8,600 ft. from May and June, and again in August to September. Mr. Inglis has also taken it in April but it is rare during that month. Mr. Inglis, Mr. Shaw and myself took upwards of forty specimens at the end of May along the beds of streams, usually settled on rocks, and never engaging in sustained flight like *besignata*. This species is, I think, more nearly related to *cuneata* than to *bifasciata*, but appears to link up groups *cuneata* and *bifasciata*, and may have originated by a fusion of the opaque bands of *trifasciata*. Type in the British Museum.

Rhinocypha immaculata Selys. Bull. Acad. Belg. (2) xlvii, p. 385 (1853); Kirby, Cat. Odon. p. 113 (misprinted as *unimaculata*), 1890; Laid. Rec. Ind. Mus., vol. xiii, pp. 34, 35 (1917).

Male. Abdomen 22 to 25 mm. Hindwing 27 to 28 mm.

Head black marked with blue and ochreous spots as follows:—The bases of mandibles, the cheeks, and a stripe bordering the eyes, a reniform spot on each side of the frons, and a smaller rounded spot just behind these pale blue. An oval spot on the outer side of each posterior ocellus and a round postocular spot on each side of the occiput ochreous. Labium and labrum unmarked.

Prothorax black marked with a middorsal longitudinal blue line beginning on the posterior lobe, and a large spot on each side.

Thorax black marked with bright yellow as follows:—A fine lower antehumeral stripe, a fine upper humeral incomplete below, a small upper spot near the first suture, a thick irregular broken stripe on lower part of sides consisting of a triangular spot on the metepimeron and an irregular longitudinal stripe on the mesepimeron. Four to six yellow spots on underside of thorax. The mesothoracic triangle very large, extending from anterior border of thorax to the alar sinus, pale blue in colour.

Legs black, the hinder pairs of femora yellow on flexor surface, the tibiæ of the same legs pruinosed white.

Abdomen black marked with yellow as follows:—A small spot on each side of segment 1, a lateral stripe and an apical spot in line with former on segments 2 to 5, finally a ventro-lateral stripe on segments 3 to 6, not extending as far as apex of segment.

Anal appendages black, shaped as for genus.

Wings entirely hyaline, the only species of the genus in which they are so. Shaped as for *trifasciata*, 15 to 16 antenodal nervures, discoidal cells with 5 to 6 traversing nervures; pterostigma blackish brown, the outer and costal part much paler or yellowish.

Female. Abdomen 22 mm. Hindwing 28 to 30 mm.

Very similar to the male. The markings of the head better defined, and all bright yellow in colour.

Thorax with a large mesothoracic triangle, outlined in yellow, black at its centre, other markings rather broader.

Legs black, not pruinosed.

Wings hyaline, occasionally enfumed in old adults; pterostigma black, whitish in its outer part; antenodal nervures 16 in number.

Abdomen black marked as for the male described above. In very adult males, the lateral stripes on 3 to 6 are lost, the apical spot alone remaining, or even lost on segments 4 to 6.

Anal appendages and vulvar scale as for genus.

Distribution. Known only from Cherrapunji, Khasia Hills, Assam. On the wing during September and October. This interesting species is easily distinguished from all others by the total absence of markings on the wings or even vitreous iridescense. Cherrapunji being about the wettest spot on earth, approaches the primitive conditions in which the ancestral dragonflies first evolved and so might be expected to preserve those forms lacking in heliochromatic markings. *Immaculata* undoubtedly stands somewhere near the base of genus *Rhinocypha*.

Rhinocypha hilaryæ, Fras. Rec. Ind. Mus., *M.S.*

Male. Abdomen 21-22 mm. Hindwing 27 mm.

Head : labium black, the lateral lobes creamy white ; labrum azure blue, its anterior border and base narrowly black, the basal black with a median point ; epistome glossy black in front, velvety black above, with a small triangular spot of blue on each side ; frons with a large quadrangular blue spot on each side with its outer angle pointed and prolonged outward, the two spots very narrowly separated, and confluent with two large subrotundate spots of the same colour on the vertex, which lie in close apposition to the median ocellus. Laterally the bases of mandibles, the penultimate segment of antennæ, and a narrow irregular stripe bordering the eyes bluish. Lastly a tiny point on the outer side of each lateral ocellus, another on each side of occiput and a small linear spot at its middle. (In dried specimens, these markings are yellow or greenish blue, but in life, the adult markings are always blue.)

Prothorax black marked with blue, bluish green or yellow according to the age of specimen :—A narrow median linear stripe which begins on the posterior lobe and tapers to infinity anteriorly, a small triangular spot on each side of posterior lobe and a short oval spot on each side middle lobe.

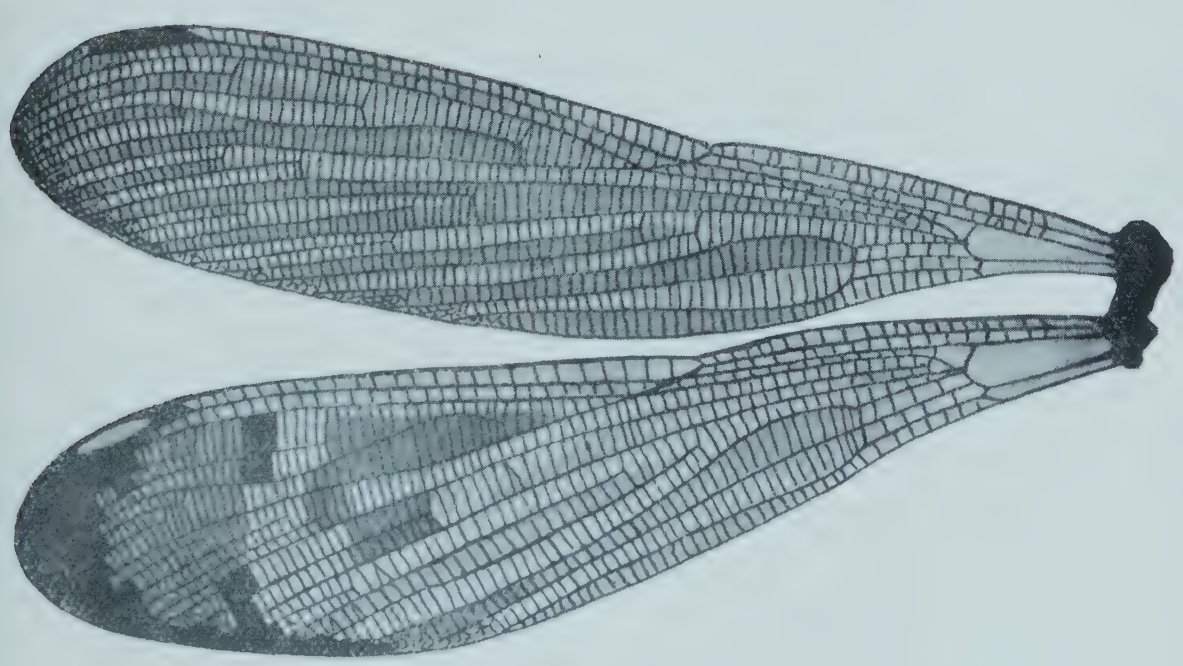
Thorax black marked with blue and yellow as follows :—The mesothoracic triangle pale turquoise blue, elongate, extending as far up as alar sinus, a fine humeral stripe azure blue, laterally an irregular thick interrupted stripe extending the whole length of thorax, rather zig-zagged anteriorly and broadened into an elongate triangular spot on the metepimeron.

Legs black, the two hinder pairs of tibiæ and distal parts of the same femora pruinosed white on the flexor surfaces.

Wings hyaline, palely enfumed with greenish yellow, marked with opaque black and vitreous violet areas as follows :—Forewing with only the extreme apex bordered or clouded with opaque black ; pterostigma black ; hindwing with apex broadly opaque black, the inner border of the opaque area serrated, running almost straight back from middle of pterostigma to hinder border of wing, and finally continued as a narrow border along the hinder edge of wing for about its apical fourth. At a short distance from the proximal end of pterostigma is seen a narrow opaque black fascia nearly always broadly broken at its middle into a small quadrate or angulate spot lying between *Rii* and *IRii*, and a markedly irregular spot confluent with the narrow black bordering of wing. Rarely the two spots are united by a narrow isthmus, but in no two specimens are they ever exactly alike. The vitreous violet areas comprise the whole of the area included between the apical black bordering and the irregular fascia, as well as three linear spots situate between the level of node and narrow black fascia, nearer the latter than former. Of these, the anterior stripe is the longest, about 20-25 cells long, and situated between *Rii* and *Riii*, the median stripe, lying between IRiii and *Riv* + *v*, is half the length of the former, its outer end in line with the outer end of same ; finally the third or hinder spot, lying between *MA* and *Cuii*, is very narrow and continues outward along posterior border of wing to become confluent with the narrow opaque black border ; pterostigma black with a large oval pale blue spot in its outer two-thirds ; discoidal cell traversed 4 to 5 times ; petiolation variable, begins opposite the 2nd or 3rd antenodal, but is usually opposite the 2nd ; 17-19 antenodal nervures, 28-38 postnodal nervures (very variable).



1. WINGS OF *Rhinocypha bifenestrata*, FRAS., MALE



2. WINGS OF *Rhinocypha hilaryæ*, FRAS., MALE

Abdomen black marked with bluish green or yellow as follows :—Segment 1 with a large lateral triangular spot on each side, segment 2 with a similar spot situate at the apex, as well as a ventral stripe nearer the apex than base of segment ; segment 3 similar, but the apical spot smaller and the ventral stripe longer, extending for nearly the whole length of segment, segments 4 and 5 similar to 3, but the markings becoming obsolete, 6 and 7 with vestigial ventral stripes only.

Anal appendages similar to genus.

Female. Abdomen 21–22 mm. Hindwing 30–32 mm.

Head. Markings similar to those of male but bright yellow instead of blue. The lateral spot on epistome larger, and in addition, a lateral stripe on either side of its front.

Prothorax similar to male.

Thorax black marked with bright yellow as follows :—The mesothoracic triangle outlined in yellow, the two lateral lines converging and fusing above and then continued as a median line bisecting the antealar sinus. A fine complete antehumeral stripe curving slightly out above, and in below ; a fine humeral stripe incomplete below ; a strongly curved stripe on upper part of mesopimeron, and lastly the same broad irregular stripe traversing the whole length of lower part of thorax, as seen in the male.

Wings hyaline, palely enfumed throughout, tinted slightly with yellow, especially at the base ; pterostigma black, its outer part bearing a broad oval yellowish spot ; 15–19 antenodal nervures, 26–31 postnodals ; discoidal cell traversed 2-4 times ; petiolation begins between the 1st and 2nd antenodals.

Abdomen black, similar to the male but markings yellow : segments 2 and 3 have also a lateral stripe lying above and parallel to the ventral stripe, in line with but not confluent with the apical spot, whilst the ventral stripe is obsolete after segment 3 and all markings after segment 6.

Anal appendages and vulvar scale as for genus.

Distribution. Maymyo, Upper Burma. Quite a number of both sexes were taken by Col. F. Wall, I.M.S., during the months of June, July and August. The insect appears to be remarkably local which may account for so striking and beautiful insect not having been discovered before. The shape of the mesothoracic triangle and the wings show it to belong to group *bifasciata*. It can only be confounded with *bifasciata*, in which however the proximal fascia is complete and situated much nearer the node, the vitreous area also covering nearly the entire wings.

(*To be continued*)

BIRD NOTES
FROM THE MOUNT EVEREST EXPEDITION OF 1924

BY

MAJOR R. W. G. HINGSTON, I.M.S.

(*With a plate.*)

The following notes are necessarily scrappy. Owing to the religious scruples of the people all shooting was prohibited in Tibet. We took no collecting-guns into the country. My notes are thus confined to field observations, and to those species which could be definitely identified. A collection of skins from the same area had previously been made by Mr. Wollaston during the first Mount Everest Expedition. A report on these was prepared by Mr. N. B. Kinnear and published in the Ibis for July 1922. This report has been of the greatest help in the identification of many species. Mr. Kinnear also supplied special notes to the expedition, and gave me much assistance after its return. I also had the advantage of Colonel Norton's help and his detailed knowledge of Tibetan birds. When at Darjeeling, Mr. C. M. Inglis showed me his collection of skins which included almost all those likely to be met with on the plateau. The birds of Tibet are unusually distinctive, and by making use of the above sources of information it was possible in almost all cases to identify the species in the field.

Corvus corax tibetanus. The Himalayan Raven.

A common bird of the Tibetan plateau. One of the chief scavengers of villages. Haunts forts. Comes to camps. Takes the place of vultures in devouring carcasses. Seen at the base-camp, 16,500 feet; at the summit of the Pang La, 17,200 feet; at Camp 3 on Mount Everest, 21,000 feet.

Corvus coronoides intermedius. The Himalayan Jungle Crow.

Common all through the Chumbi and Rongshar valleys. Seeks the vicinity of villages and cultivation. Associates with choughs above the level of the trees. Nests at Gautsa, 11,500 feet. Also met with on the plateau, though partially replaced there by the raven. Followed us up to Camp 3 at 21,000 feet

Pica pica bottanensis. The Black-rumped Magpie.

A village bird of the Tibetan Plateau, 13,500 to 15,000 feet. Frequents buildings, cliffs and cultivated fields. In the few places where there is a clump of trees magpies are certain to be found. Nests seen at Khampa Dzong, 14,000 feet, on a solitary village tree: at Kyishong, 14,000 feet on the top of a low bush only six feet above the ground: at Shekar, 14,000 feet, similarly situated in a thorn bush. These nests are immense and very conspicuous. They appear to be permanent habitations which serve in winter as a shelter for the birds. The distribution of the species must be chiefly limited by the few places available for the building of nests.

Nucifraga caryocatactes hemispila. The Himalayan Nutcracker.

Seen frequently during June in the Rongshar valley that leads from Tibet into Nepal on the west side of Mount Everest. Altitude 9,000 to 10,000 feet. In 1922 Colonel Norton observed it in the Karma valley during June at 13,000 feet.

Pyrrhocorax pyrrhocorax. The Common Chough.

Noisy flocks common in the Chumbi valley up to the summit of the Jelap La, 10,000 to 14,000 feet. Haunt the high cliffs and caves in the rocks. Abundant around the forts of Tinki and Shekar where numbers of them nest in holes. Flocks feed in the cultivated fields of the plateau, where, though joining in a gregarious company, they yet scatter about in individual pairs. Also met with in the Rongshar valley at 11,000 feet. Nests taken (1) on 10th July at Kyishong, 14,500 feet; situated in hole on earth cliff; contained young; (2) on April 17th in Chumbi valley at 10,000 feet; situated in recess under eaves of house; composed of sticks thickly lined with moss and wool; contained three eggs newly laid. This chough was not seen above 15,000 feet.



CHOUGHS IN EVEREST BASE CAMP.



BLUE HILL-PIGEONS IN EVEREST BASE CAMP.



BROWN ACCENTOR IN EVEREST BASE CAMP.



ADAMS'S MOUNTAIN-FINCH IN EVEREST BASE CAMP.

Pyrrhocorax graculus. The Aipine Chough.

A bird of higher altitudes than the previous species. A permanent resident of our base-camp at 16,500 feet. In camp it was extremely tame, as impudent and daring as the housecrow, living on the scraps thrown out of the cooking-place, and spending the day amongst our tents. On the cliffs it used to associate with herds of Burhel, picking insects out of their hair. It came regularly to Camp 1 at 18,000 feet, and to Camp 3 at 21,000 feet. Somervell saw flocks around the summit of Kharta Phu at 23,640 feet. These birds followed the climbers to all the high camps, reaching even Camp 6 at 27,000 feet. This is the greatest height at which living things have yet been seen.

Podoces humilis. Hume's Ground-Chough.

A common bird of the Tibetan plateau up to 15,000 feet. Also seen within Indian limits, at Tangu in Northern Sikhim, near the Tibetan border, altitude 14,300 feet. An active little bird with feeble powers of flight. Assumes a peculiarly erect attitude, moves over the ground in long hops, bowing its head and flirting its tail. Frequents stone walls, the roofs of buildings, enters villages freely, sometimes found in the most barren tracts. Harmonizes well with its plateau haunts. Bores into the soil in search of food. Frequently investigates animal droppings, breaking them and turning them with its strong beak. Remains of ground-beetles found in its stomach. Nest found at Tingri on July 4th ; altitude 15,000 feet. Situated far down in deserted pika burrow. I followed down the burrow for four feet, but was still far from reaching the nest. The parent birds came round with morsels in their beaks showing that the nest contained young.

Parus monticola. The Green-backed Tit.

A common bird of the Chumbi valley where it joins with warblers in an insectivorous flock.

Lophophanes rufonuchalis beavani. The Sikkim Black Titmouse.

A flock of tits, probably this species seen in the silver fir trees below the Jelap La at 11,000 feet.

Trochalopterum affine affine. The Black-faced Laughing Thrush.

A common bird of the Chumbi valley. Often seen skulking in bushes near the torrent, but not noticed above the trees. A small flock was seen amongst the conifers at 13,000 feet.

Myiophoneus temminckii. The Himalayan Whistling Thrush.

Common in all the high Himalayan gorges. Seen in the streams of the Chumbi valley up to 12,000 feet. Also up to the same altitude in the Rongshar gorge.

Tichodroma muraria. The Wall Creeper.

Seen first in the Chumbi valley clinging to boulders in the valley bed. Occasionally met with on the Tibetan plateau, on the slatey rocks at Shekar, 14,000 feet ; on the high cliffs of the Dzakar Chu at 15,000 feet ; on the cliffs above our base camp in the Rongbuk valley at 18,000 feet. It finds spiders in the crevices of these high rocks, and its body harmonizes well with the background as it climbs from place to place.

Lanius schach tephronotus. The Grey-backed Shrike.

Numbers seen in the Chumbi valley at 10,000 feet. Birds arrive in the middle of April. Also seen in the Rongshar valley between 11,000 and 12,000 feet. Some birds pass over on to the Tibetan plateau. We saw one in thorny scrub near Kyishong at 15,000 feet. In 1922 Norton and Longstaff observed it along the Dzakar Chu, 14,000 feet, and the lower Phung Chu, 13,500 feet.

Oenanthe deserti oreophila. The Desert Chat.

Frequently met with on the plateau between 14,000 and 15,000 feet, and on the passes up to 17,000 feet. Particularly likes stony places where the boulders give it points of vantage. Also likes to settle on tufts of grass or clumps of thorny scrub. Seen in the valley of the Phung Chu where the ground was white with a saline efflorescence. Nest taken at Tingri on July 4, altitude

15,000 feet. Situated in tunnel on earth cliff, one foot in depth ; composed of dry grass and fine sticks thickly lined with animal hair ; contents, four eggs hard set.

Microcichla scouleri scouleri. The Little Forktail.

Not seen on the plateau, but at 9,500 feet in the deep Rongshar gorge that leads from Tibet into Nepal.

Chaimarrornis leucocephalus. The White-headed Redstart.

Common in the high Himalayan streams. Not seen on the open plateau. Met with at Gautsa, 12,000 feet, near the furthest limit of the trees. Very common throughout the Rongshar gorge up to 13,000 feet.

Phœnicurus frontalis. The Blue-fronted Redstart.

Extremely abundant through the Chumbi valley, 10,000 to 11,000 feet. Only a few had arrived by the beginning of April, though numbers were present later in the year, seen on the Jelap La at 13,000 feet, but does not seem to cross over on to the plateau.

Phœnicurus hodgsoni. Hodgson's Redstart.

A bird, which I take to be this species, was twice seen on the plateau ; in the ploughed fields near Tashidzom at 14,500 feet ; and at the fort of Shekar, 14,000 feet. There is no mention of this species in Mr. Kinnear's list of the birds of the first Expedition.

Phœnicurus ochrurus rufiventris. The Indian Redstart.

Frequently met with on the Tibetan plateau between 13,000 and 16,000 feet. Frequents stony wastes, rocky hillsides. Comes around villages, and especially likes the grassy patches where it captures insects in a few quick hops. It occasionally came to the Everest base camp at 16,500 feet. We met it at a similar altitude on the Pang La, though not at anything approaching Wollaston's record of 20,000 feet.

Phœnicurus erythrogaster grandis. Guldenstadt's Afghan Redstart.

Met with occasionally at high altitudes : on the summit of the Kongra La, 16,000 feet ; in the Rongbuk valley, 16,000 feet ; on both sides of the Phusi La, 16,500 feet. It ascends to the junction of the torrents with the glaciers. Seen on Mount Everest up to 18,000 feet where it visited both our base camp and Camp 1. Its habits are like those of the white-capped species which it replaces at greater heights. It takes insects amongst the boulders along the torrent, and alights as readily on pinnacles of ice as it does on rocks and stones. A pair had a nest near the base camp at 16,000 feet.

Rhyacornis fuliginosa. The Plumbeous Redstart.

Very common in the streams of the Chumbi valley up to 12,000 feet. Also through the Rongshar gorge up to about the same altitude. Apparently does not pass on to the Tibetan plateau.

Ianthia rufilata. The Red-flanked Bush-Robin.

Common in the Chumbi valley up to 11,500 feet. Apparently does not cross over on to the plateau.

Planesticus merula. The Himalayan Blackbird.

Seen only on one occasion : in thorny gorse near Kyishong at 15,000 feet.

Planesticus albicinctus. The White-collared Ouzel.

Seen at Yatung in the Chumbi valley, 10,000 feet. A pair had established themselves in the scrub around the rest-house.

Merula ruficollis. The Red-throated Ouzel.

Seen in the Chumbi valley amongst scrub at the edge of the torrent, altitude 10,000 feet.

Monticola solitaria pandoo. The Indian Blue Rock Thrush.

Seen in July by Norton in the Rongshar valley at 16,000 feet. Not met with on the Tibetan plateau.

Cinclus cinclus kashmiriensis. The Kashmir Dipper.

An inhabitant of the deep gorges. Nowhere seen in the more peaceful streams of the plateau. Met with in the Chumbi valley at 10,000 feet, above Gautsa at 14,000 feet, in the Rongshar torrent at 10,000 feet.

Lioscopus collaris nepalensis. The Eastern Alpine Accentor.

Not seen on the open plateau. Met with below the Jelap La at 13,000 feet; also near the head of the Rongshar valley at 15,000 feet. Wollaston saw this bird at the great height of 21,000 feet.

Prunella rubeculoides. The Robin Accentor.

Widespread on the Tibetan plateau, 14,000 to 16,500 feet. Seen at almost every village. Also at Gautsa in the Chumbi valley, 13,000 feet. It haunts the boundary walls between the cultivated fields and the rocks near Tibetan forts. May be seen skulking in nullahs and water-channels and under moraine boulders. Its village habits are like those of the brown accentor. It feeds mainly near the village walls where it picks seeds out of animal dung. Numbers were seen at the village of Kyishong in company with the brown accentor. It was met with on the moraines at Kyetrak, 16,000 feet; also as a visitor to the Everest base camp at 16,500 feet.

Prunella fulvescens fulvescens. The Brown Accentor.

A common bird of the plateau. Frequents villages, stone bridges, chortens, mani-walls, which places supply nooks where it can skulk and hide. Finds food amongst village refuse in the streets and in the manure-heaps on the roofs of houses. Seen on the Pang La at 17,000 feet. Also came to boulders near our base camp at 16,500 feet. Numbers were seen in the willows at Kyishong. But, since trees in Tibet are so very scarce, the accentors, like the magpies and the tree-sparrows, have become almost altogether village birds. They were as common as sparrows in the little village of Kyishong. Longstaff records a pair nesting in May at the Everest base camp. Nest composed of a cup of fine grass lined with bits of wool and hair placed on a platform of sticks in a deep gap between expedition ration boxes.

Prunella strophiatus strophiatus. The Rufous-breasted Accentor.

Seen only in the Chumbi valley. Small flocks were common on stone walls and in low scrub, altitude 10,000 feet.

Pyrrhula erythrocephala. The Red-headed Bullfinch.

A few pairs seen in the Chumbi valley, 11,000 to 12,000 feet. Also in the deep Rongshar gorge at 12,000 feet.

Pyrrhospiza punicea punicea. The Red-breasted Rose-Finch.

A bird of the Tibetan plateau. Seen at Kyishong and Tashidzom, altitude 14,000 feet. Also on the Phusi La at 16,500 feet. Occupies willow plantations. Haunts villages and frequents cultivated fields. In a flock the females are far more numerous than the males.

Propasser pulcherrimus. Subsp.? The Beautiful Rose-finch.

Seen in the Chumbi valley. A pair in rhododendron scrub on the Jelap La at 13,000 feet. Also in the snow at Chumbitung, 12,500 feet. These birds shelter from the snow under ledges of rock, or, like sparrows, beneath the eaves of rest-houses.

Carpodacus rubecilloides. Przewalski's Rose-Finch.

A bird of the plateau. Seen at Khampa Dzong, Lingka, Tinki Dzong, altitude 14,500 feet. Comes about villages. Feeds in cultivated fields. Longstaff in 1922 noted it at Tinki Dzong.

Acanthis flavirostris rufotriata. Walton's Twite.

Frequently met with on the plateau in July. Not seen in April. Haunts grassy tracts and cultivated land. Altitude, 13,500 to 14,500 feet.

Passer montanus. Subsp. ?. The Tree Sparrow.

Common around all human habitations. Almost exclusively a village bird. Congregates in flocks. Strikingly tame. Likes the vicinity of vegetation. Feeds in the streets and at village walls. Replaces the domestic sparrow around human habitations, yet likes trees when they are available, though such are rare in Tibet.

Montifringilla blanfordi. Blanford's Mountain-Finch.

Fairly common on the plateau at 14,000 to 15,000 feet. Seen around villages and in cultivated fields. Associates with Pikas in grassy places. Feeds with sparrows near the walls of houses, sometimes in considerable flocks. Nest at Shekar on July 7, altitude 15,000 feet; situated at bottom of a deep pika burrow; nest in process of being built, and parent birds busy bringing feathers and hair. Longstaff in 1922 met with a nest at Trangso Chumbab on June 11, altitude 14,000 feet. Female was netted at nesting hole and identified. Both parents were feeding young more than four feet down mouse-hare hole. He imprisoned male in the hole beneath a foot of sand through which it burrowed during the night. Longstaff states that both birds burrow very quickly, using the bill only, with a quick rotary movement sending the sand flying centrifugally. Norton records the Pika burrows at Tatzang covered with these finches on July 17; and observed them feeding well grown young near Phari, 14,000 feet, on July 20.

Montifringilla ruficollis. The Red-necked Mountain-Finch.

A delightful little bird living in the company of mouse-hares and feeding around the mouths of their burrows. Common on the grassy plains of the plateau and wherever there are pika colonies. Altitude 14,000 to 15,000 feet. Norton notes it at Gnatong April 1, at Yatung April 4, at Phari April 7.

Montifringilla mandelli. Mandelli's Mountain-Finch.

A bird of local distribution. Seen on the Phari plain, the Tingri plain, and the large plain on the further side of the Donka La, but not at intervening places. Lives in the company of pikas. Seen entering pika burrows where it undoubtedly breeds.

Montifringilla nivalis adamsi. Adams's Mountain-Finch.

Seen occasionally on the plateau. At Gyankar Nangpa, 14,000 feet: at Chiblung, 14,500 feet; at Shekar, 15,000 feet. An occasional visitor to the Everest base camp at 16,500 feet. Nested close to the base camp in June. Feathers were being carried into a tunnel in the moraine, but the nest could not be reached as it was more than an arm's length down the hole. In 1922 Norton met with it constantly from Phari to Everest, except in the Karma and Kharta valleys, but not below 13,500 feet.

Fringillauda nemoricola nemoricola. Hodgson's Mountain-Finch.

A common bird of the plateau, from 14,000 to 17,000 feet. Remarkably tame. Comes about villages. Frequents grassy patches and cultivated fields. Picks in the dung with tree-sparrows around the houses. Also found in barren stony wastes. A common resident of our Everest base camp. Apparently likes to haunt the passes. Seen on ascent and descent of Phusi La, 16,000 to 17,000 feet; and near the summit of the Lamna La at 17,000 feet. In 1922 Longstaff notes that a pair frequented the Everest base camp during May and that small flocks were met with on the slopes leading up to the Sepo La at 17,000 feet. Norton notes it as common everywhere high up, but not seen in Karma or Kharta valleys or lower Phung Chu. He met a pair at Camp 1 on Mount Everest, altitude 18,000 feet.

Cotile riparia. The Sand Martin.

Sand Martins were fairly common on the plateau up to 14,500 feet. Seen busily circling over the streams and lakes at Tinki, Tingri and Shekar. Norton during the second expedition, on April 18, observed numbers around Tinki lake, apparently having just arrived, as none had been there on the previous day.

Ptyonoprogne rupestris. The Rock Martin.

Haunts places on the plateau where there are crags and cliffs. Seen in the gorge near Shillong, 14,000 feet; around the cliffs above Kyishong; and in the gorge at Khampa Dzong, 14,500 feet.

Motacilla alboides. Hodgson's Pied Wagtail.

Frequently seen along mountain torrents; in the Chumbi valley at 10,000 feet: above Gautsa at 13,500 feet. Also along the plateau streams at about 14,000 feet: and throughout the Rongshar gorge between 9,000 and 11,000 feet.

Motacilla citreola calcaratus. Hodgson's Yellow Wagtail.

Met with on the plateau in marshy places and at the edges of lakes. Altitude 13,500 to 15,000 feet. In 1922 Norton and Longstaff noted it at Gyanka Nampa and along the Chiblung Chu.

Anthus roseatus. Hodgson's Pipit.

Numbers during April in the Chumbi valley, probably migrating to higher altitudes. Also seen in July in the Rongshar valley at 15,000 feet. Not noticed on the Tibetan plateau. In 1922 Norton observed it below the Chog La at 15,000 feet, probably nesting.

Otocoris alpestris elwesi. Elwes's Shore-Lark.

Abundant and widespread on the plateau. A common bird of every village. It is usual to see hill-pigeons, tree-sparrows, accentors, horned larks and others feeding near the village wall. It also frequents cultivated fields. Enters into association with the Pikas that tunnel everywhere into the plateau soil. Feeds at refuse heaps and in patches of grass. Seems to find food in the barest place. The stomachs of a few examined contained small seeds and fine grit. Very common on the large plains, such as those near Phari, Tingri and Tuna. Apparently likes to haunt the passes. Seen on the ascent to the Lamna La at 16,000 feet, to the Phusi La at 16,500 feet, to the Pang La at 17,000 feet. Also on the moraine of the Rongbuk glacier at 18,000 feet. Used frequently to visit our Everest base camp where it found scraps amongst the tents. Nests taken,—(1) At Tingri, July 4, 15,000 feet; in cavity on earth bank; composed of grass lined with vegetable down; contained three eggs newly laid. (2) At Kyishong, July 10, 14,500 feet; in depression on ground behind ridge of earth; composed of grass lined with hair; contained two eggs hard set.

Melanocorypha maxima. The Long-billed Calandra Lark.

A conspicuous bird of the plateau. Frequents grassy and marshy places up to 15,000 feet. Utters a loud call note when in flight. Nest containing three young nearly fully fledged taken at Tingri on July 4, altitude 14,500 feet. A second nest with three young half fledged taken at Tingri on July 6, altitude 15,000 feet. Both nests composed exclusively of dried grass, and situated on an elevation in swampy ground sheltered by a stiff tuft of grass.

Alauda inopinata. The Tibetan Skylark.

Found in pasture areas and cultivated fields of the plateau. They follow the plough in search of food. Seen up to 15,000 feet. Numbers in July over the cultivated tracts near Tingri were singing and soaring like the English skylark.

Calandrella acutirostris tibetana. The Tibetan Short-toed Lark.

The most common bird of the plateau: altitude 13,000 to 15,000 feet Abundant everywhere: around villages, in cultivated fields, in marshy places on the salt-covered plains, at the edges of streams and pools. Have seen a flock of them busy on a frozen lake where they seemed to pick up something from the surface of the ice. They particularly frequent fields freshly turned over by the plough. Nests taken.—(1) At Shekar on July 7; altitude 15,000 feet; composed of grass lined with hair; situated in depression on ground under lee of tuft of vetch; contained three eggs hard set. (2) At Shekar on July 7; altitude 15,000 feet; composed exclusively of dry grass: situated in depression on sandy soil under shelter of an iris plant: contained two eggs hard set. (3) At Kyishong on July 11, altitude 14,500 feet: situated in depression on ground under shelter of vetch: composed of dried grass with the interior intermingled with a little hair; contained three eggs. (4) At Chiblung on

July 13, altitude 14,500 feet: situated in hollow on ground under shelter of vetch : composed of dried grass : contained three eggs. This last nest was of particular interest. On its exposed side was a barrier of pebbles, from ½ to 1 inch in width. This had probably been erected by the bird as a protective shelter from the wind. Buxton describes similar examples from deserts. How animals adapt themselves to wind, cold, scarcity of food and other conditions of high altitudes has been discussed in a paper ' Animal Life at High Altitudes ' published in *The Geographical Journal*, vol. lxv, No. 3, March 1925.

Upupa epops orientalis. The Hoopœ.

Common everywhere on the plateau where it seems out of place in these desolate heights. Not seen above 15,000 feet, though Wollaston observed it at 21,000 feet. In the main a village bird ; also likes to feed on grassy patches where the ground is wet and soft. Sometimes seen far out on the stony plains, even in the most barren spots. Haunts forts and ruined walls. In July many were nesting in holes on earth cliffs. In 1922 Longstaff records a nest with six fresh eggs in clean hole in mud wall on June 7, at Nyomda, 14,000 feet. Norton found a nest with young on July 1, in a loose stone wall near Teng.

Athene noctua bactriana. Hutton's Owlet.

A single bird flushed from heavy grass on the Lingka plain, altitude 14,500 feet.

Gyps himalayensis. The Himalayan Griffon.

Commonly seen in the mountainous valleys that lead from the plateau into the main range. Noticed only occasionally on the open plateau where its place is taken by the Lammergeyer. Seems to like circling over high passes. Some were feeding at carrion on the summit of the Pang La, 17,200 ft.

Gypaëtus barbatus grandis. The Eastern Bearded Vulture.

Numerous on the Tibetan plateau. A scavenger around the village wall where it finds carcasses and bones. Likes to circle over high passes and around the rocky Tibetan forts. In its flight it is sometimes molested by choughs. Ascends to considerable altitudes. A constant visitor to our base camp ; also to camps 1, 2 and 3, up to 21,000 feet. Sometimes, when flying over snow, its under parts look completely white.

Cuncuma leucoryphus. Pallas's Fishing-Eagle.

Seen occasionally near the rivers and marshes of the plateau ; 14,000 to 15,000 feet.

Milvus migrans lineatus. The Black-eared Kite.

Common on the plateau. An occasional visitor to our base camp. Kites and ravens are the two scavengers that fight over the village scraps. In 1922 Norton observed it in June and July nesting and feeding young at two or three places in the Dzakar Chu.

Falco tinnunculus. The Kestrel.

Seen frequently on the plateau up to 15,000 feet. Likes to investigate marshy places and the grassy areas inhabited by mouse-hares. Has few points of vantage from which to search for prey, and must do most of its scrutiny by poising in the air. The Kestrel and the Tibetan Tern are the two birds of these high altitudes which by hovering can hold themselves at a fixed point. Of all ærial evolutions this capacity to poise stationary in the air requires the greatest amount of muscular effort, yet these two birds can poise stationary at 15,000 feet, where the supporting power of the atmosphere is only half that at sea level, with the same skill and apparently the same facility as do kestrels and terns at ordinary altitudes.

Columba rupestris. The Indian Blue Hill-Pigeon.

A bird of the plateau. Commonly seen in flocks. Abundant everywhere, around resthouses, villages and forts. Harmonizes fairly well with the plateau soil. Unlike *C. leuconota* it haunts the round hills and open valleys as well as the precipitous cliffs. Likes to frequent caves and ruined buildings ; is very common in Tibetan villages, and comes to cultivated fields. Feeds regularly in

the village streets. Haunts the stone bridges across the streams. Nests in the Tibetan forts, such as those at Khampa, Tinki, and Shekar. One of the regular visitors to our base camp where it walked fearlessly amongst our tents like the pigeons in a city street. Also ascended to the higher camps. Made daily visits to Camp 1 at 18,000 feet, and seen sometimes at Camp 2 at 20,000 feet.

Columba leuconota leuconota. The Snow Pigeon.

Not seen on the plateau. Prefers to haunt precipitous cliffs. An inhabitant of the rocky gorges leading from the plateau into the main range. Seen in the Rongshar and Gautsa gorges between 12,000 and 13,500 feet.

Turtur orientalis. The Rufous Turtle-Dove.

Frequently observed in the Chumbi valley, usually amongst the trees at the edge of the torrent. Seen as high as Gautsa at 11,500 feet and at Chumbitang, 12,000 feet. A pair were observed on the plateau in a willow plantation at Tashidzong, 14,500 feet. This makes an addition to the birds mentioned in Wollaston's list. Norton in 1922 noted it as common in the lower Phung Chu, lower Dzakar Chu, Kharta and Kama valleys.

Syrrhaptes tibetanus. The Tibetan Sandgrouse.

Seen only at one place on the plateau, at Giri, 14,700 feet. Flocks were there common on the stony soil feeding along the margin of the stream. They harmonized well with their barren haunts.

Lophophorus impejanus. The Monal.

Seen in both the Chumbi and Rongshar valleys at about 12,000 feet.

Ithagenes cruentus. The Blood-Pheasant.

Seen on the descent from the Jelap La at 11,500 feet. Also in the Chumbi valley at 13,000 feet. Norton saw it at Sakyeteng in the Karma valley in 1922.

Perdix hodgsoniæ hodgsoniæ. The Tibetan Partridge.

Seen in pairs on the stony hills between 13,000 and 15,000 feet. Fairly common. Usually frequents the low scrub that collects around the base of some of the hills. Also enters cultivated fields. Longstaff in 1922 met with it on the Tinka La at 16,000 feet and at Kyishong 13,500 feet. Norton saw 'a lot with some half grown cheepers' in the lower Dzakar Chu valley on July 6.

Tetraogallus tibetanus. The East Tibetan Snow-Cock.

Snow-cock are amongst the common birds of the plateau. Their whistlings and chucklings are characteristic sounds. They frequent the barren stony hills where their plumage harmonizes well with the rock. Commonly seen near the summits of the passes up to 17,000 feet. In some places they are remarkably tame. We used to chase them on horseback and pelt them with stones. At our base camp in the Rongbuk valley they came within a few yards of our tents. Longstaff records it on Everest at 18,000 feet.

Megalornis nigricollis. The Black-necked Crane.

A pair were seen at Tingri on July 7, altitude 15,000 feet. In 1922 Longstaff and Norton saw and photographed a pair on the Tinki plain on June 15.

Cirripedesmus mongolicus atrifrons. The Central Asian Lesser Sand-Plover.

Seen in muddy river beds and along the banks of streams. Also in marshes and at edges of lakes. Fairly common on the plateau between 13,000 and 15,000 feet. In July a pair were nesting near Tingri at 16,000 feet. They

adopted the usual ruse of the plovers. In a crouching attitude, with head bent almost to the ground, with tail expanded so as to display the white lateral feathers, wings drooping as if to simulate injury, the parent bird ran quickly through the short grass as if trying to lure the intruder away. Longstaff observed this plover in June on the Sepo La at 17,000 feet.

Ibidorhynchus struthersi. The Ibis Bill.

Not seen on the plateau. Frequents the streams in the mountain gorges that flow from the plateau into the main range. Met with in the Chumbi valley at 13,500 feet and in the Rongshar valley at 10,000 feet. Harmonizes most perfectly with the water-worn boulders amongst which it is accustomed to feed. Young were seen in June crouching amongst boulders on an island in the Rongshar stream. The reason why this bird has a bill with so peculiar a curve is disclosed by observing its behaviour. It runs about on the water-worn boulders, sometimes wading into the torrent up to its breast, thrusting its long bill under the round stones in the hope of finding insects beneath them. Sometimes it curves its bill around the front of the stone, sometimes inserts it from one side. The bill is an excellent instrument for this purpose. Were it straight it would not suit the roundness of the pebbles. Its peculiar curve is a necessary part of it, and is excellently adapted to the habits of the bird. For it is curved in such a way that it fits neatly around the boulders when the bird is probing for food.

Tringa ochropus. The Green Sandpiper.

Sandpipers were seen in the pools at Khampa Dzong, 14,000 feet. A few also in other parts of the plateau. I take it that they belonged to this species.

Totanus calidris. The Redshank.

Seen frequently in the plateau marshes between 14,000 and 15,000 feet. Nest composed of loose collection of sticks taken on July 12 at Jikkyop, 14,500 feet ; contained four eggs almost hatched. Norton in 1922 met with families on July 15 near Lingka : one with four chicks of which the old birds very pluckily tried to attract him away from the brood.

Erolia temminckii. Temminck's Stint.

Noticed occasionally on the plateau. Flocks were seen on May 1, at Lingka, 14,500 feet. On May 23 a single bird came to a pool on the Rongbuk glacier at 17,000 feet. It seemed tired and was probably on migration.

Gallinago stenura. The Pin-tailed Snipe.

A snipe, flushed from marshy ground at Chodzong, 15,000 feet, probably belonged to this species.

Larus brunneicephalus. The Brown-headed Gull.

A common bird of the Tibetan plateau between 14,000 and 15,000 feet. Frequents lakes and swamps and running streams. Flocks may be seen resting on the ice in the morning waiting for the thaw to set in.

Sterna hirundo tibetana. The Tibetan Tern.

Abundant everywhere over streams and lakes between 13,000 and 15,000 feet. Frequently seen poising over and plunging into streams. Common around marshes and in the rocky gorge of the Dzakar Chu.

Anser indicus. The Bar-headed Goose.

Numerous on the plateau. Very tame. Allowed my approach to within 25 yards. Occupy all lakes and swamps, even the pools at the village walls. Well known to breed in Tibet. It is forbidden to take the eggs, yet one Tibetan official presented me with six. In 1922 goslings were observed by Longstaff on June 15. Norton records Tinki lake on July 14 as black with thousands of young birds.

Casarca ferruginea. The Ruddy Sheldrake.

Extremely common and remarkably tame. They are as fearless as the ducks in a London park. Seen on every lake and pool of the plateau between 13,000 and 15,000 feet. Usually in pairs, sometimes in small flocks, they feed with their heads deep in the water and tails high in the air. Sometimes a loud rushing noise is heard overhead which comes from a pair of sheldrake swooping down to occupy the pool. They also frequent the barren hillsides where they keep up a noisy courtship accompanied by bleating notes. It is interesting to observe their sexual enthusiasm, often at the edge of a frozen stream when the ground around them is draped in snow. Here is an example from a desolate valley in April at 14,000 feet. At the edge of the stream is an eager couple which give forth a kind of bleating note. The drake is the more ardent of the two and very persistent in his suit. From time to time he crouches low, stretches out his long goose-like neck, and makes a run towards his mate. At other times, when she is in the stream, he stretches out towards her, then utters his bleating note as if trying to call her to the bank. It is a cold desolation for such persistent enthusiasm which seems out of place amidst ice and snow. In June we saw many young on the Tingri lake ; others in July on the lakes at Tinki. Longstaff records it as a cliff breeder like Spitzbergen geese. He saw the first ducklings on June 10, which were gobbled by ravens on their journey to the river. Norton notes a fair number with families on Tinki lake, July 14.

Merganser orientalis. The Eastern Goosander.

At Kyishong, 14,500 feet, a pair seen in the river with five ducklings newly hatched.

THE RICE RATS OF LOWER SIND AND THEIR CONTROL

BY

P. V. WAGLE, M. AG.

(*With three diagrams and a plate*)

EDITED AND COMMUNICATED BY

DR. HAROLD H. MANN, DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY.

The Indus Delta in Sind is one of the most desolate pieces of country in the whole of India. With an uninteresting vegetation, a very small population, a very limited amount of cultivation compared with the vast areas available for the purpose, it is a dreary waste of waters in the inundation season, and a pastoral country utilized even for grazing only to a very small proportion of its possibilities, in the cold weather. The lack of development in this flat alluvial country in the rainy season is probably due to three chief causes,—the absence of control of the inundation water, the prevalence of intense malarial conditions, and the prevalence of field rats.

The prevalence of field rats is, in fact, one of the main causes of the limitation of cultivation, for the damage they do reduces the rice crop, which covers over 75 per cent of the cropped area, by an amount which varies in many areas from about 10 per cent to over 50 per cent of the crop. It is this which has led to the inquiry of which I propose to give an account in the present paper, as to the nature of the injurious field rats in this part of Lower Sind, and the methods which have proved successful in dealing with them.

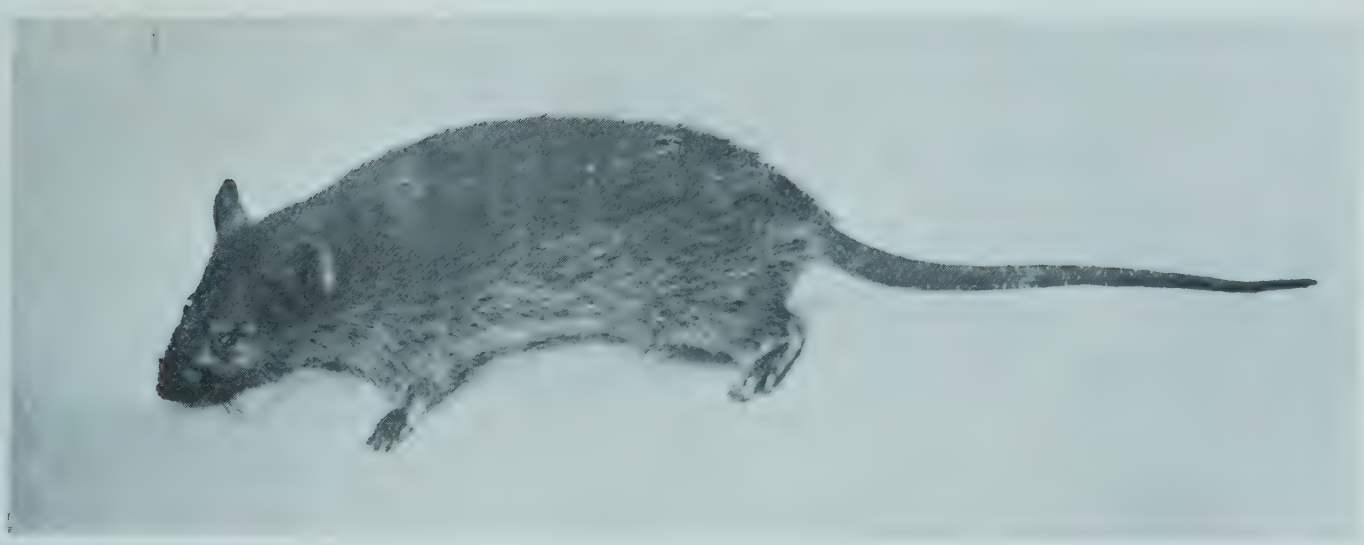
Hitherto, the species of rat inhabiting this tract have hardly been known. In 1907, the late Mr. E. H. Aitken enumerated[1] the rats of Sind as follows :— " The commonest rat in Sind is probably the Jerboa rat (*Gerbillus indicus*) or its cousin the desert Gerbille (*Gerbillus hurrianeæ*).[2] Mr. Gleadow of the Forest Department was the discoverer of another species at Rohri, the little hairy-footed Gerbille (*Gerbillus gleadowi*).[3] The common house rat in Karachi at any rate, is pure white on the under parts, but brown rats are also found : both are ranked now as varieties of *Mus rattus*. . . . The short-tailed mole rat (*Nesokia hardwickei*) is widely spread in the Province and is ranked among the enemies of the farmer. '' In 1909, it is understood from a note by Mr. Kinnear in 1919, two examples of the Sind Mole rat (*Gunomys sindicus*) were sent to the Bombay Natural History Society, with a statement that this species was a regular plague. The inquiries made in 1924 and 1925, on the spot, indicate that three kinds of rat are very abundant in the Indus delta area of the Karachi district. These are (1) the well-known Gerbil (*Cheliones hurrianæ*) originally described from Hariana in the Punjab, but found in Baluchistan, in Rajputana (Kotah), in various parts of the Punjab (Attock, Delhi) and probably over the greater part of North-west India, (2) the Sind Mole-Rat *Gunomys sindicus*, originally described from Pithoro in Eastern Sind and authentic specimens of which have not been recorded from outside the province, (3) Hutton's Mole-Rat, *Nesokia huttoni*, originally described from Kandahar, but also recorded from Baluchistan, Quetta and Sukkur. Two of these species of rats are now proved to be quite innocent of damaging the rice crop, namely *Cheliones hurrianæ* and *Nesokia huttoni*, and the injury is almost entirely, if not entirely, due to *Gunomys sindicus*, the Sind Mole-Rat, which occurs in enormous numbers in the Indus delta. There is no doubt that, in the past, a great deal of energy and money has been spent in digging out and killing the wrong species of rat.

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[1] *Sind Gazetteer* by E. H. Aitken, Karachi, 1907.
[2] Now known as *Cheliones hurrianæ*, Jerdon.
[3] Now known as *Nesokia indica*, G. & H.



THE INDIAN DESERT GERBIL (*Cheliones hurrianæ*).



THE SIND MOLE-RAT (*Gunomys sindicus*).



HUTTON'S MOLE-RAT (*Nesokia huttoni*).

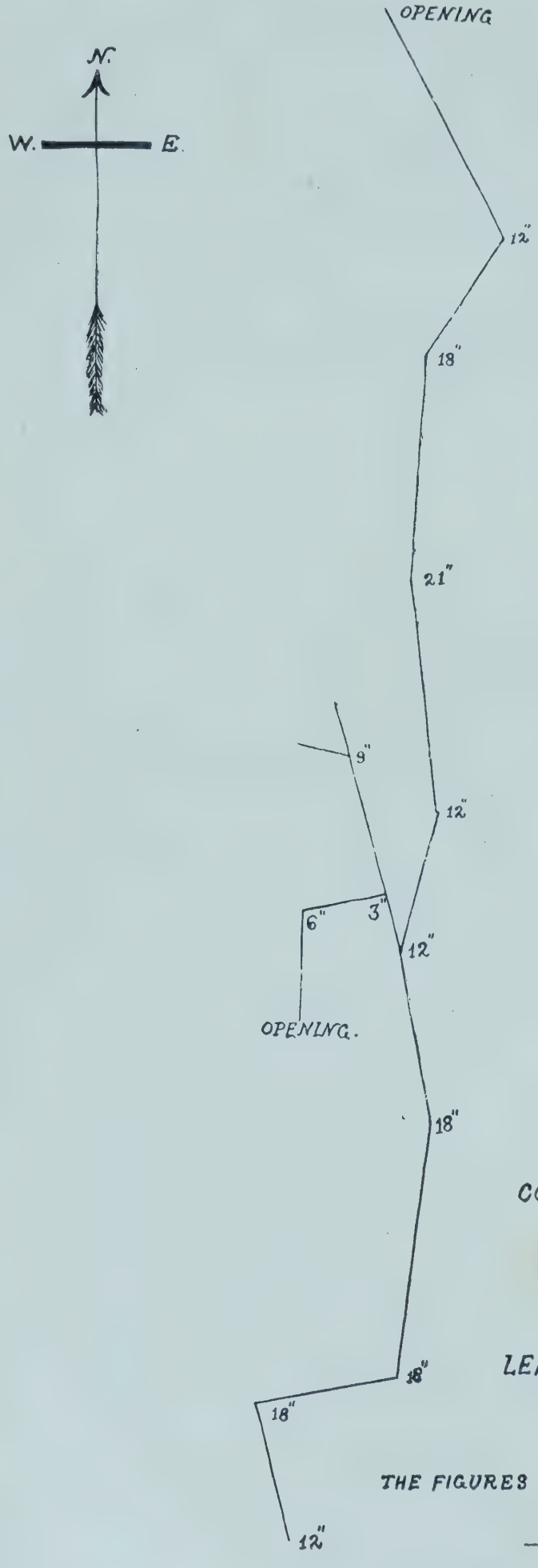


Fig. 1.

COURSE OF A RAT BURROW
IN WASTE LAND
Sp:- MERIONES hurrianae.
TATTA, 5.9.1924.
LENGTH OF MAIN BURROW – 15 FEET.
MAXIMUM DEPTH – 21" INCHES.

THE FIGURES INDICATE THE DEPTH FROM SURFACE.

SCALE



The Common Gerbil. *Cheliones hurrianæ*

The common Gerbil, *Cheliones hurrianæ*, is the smallest of the three common rats of the area. Its range of length of the head and body is defined by Wroughton as 100 to 175 mm. Two adults gave the following actual measurements :—

	I	II
	mm.	mm.
Head and Body length	105	108
Tail length	118	118
Length of Hind legs without claws	30	30
Ear length, from base	11	11

This species has very soft fur and is grey in colour, with very prominent black eyes. The ears are small and are covered with very fine soft fur. The tail long—longer than the head and body together—has a line of black hair on the dorsal side and ends in a brush of long black hair. The females have normally four pairs of mammæ two on the chest and two in the inguinal region. The adults weigh from two to three ounces.

The burrows of this rat are almost straight (*see* Fig. 1) with very little branching, and in this respect are very different from those of the other two rats to be described. They have usually two openings only, one at each end. In the burrows dug, no nest or anything of the kind was found in any one of them. The mouths of the burrows are always open and the inside is clear of loose earth.

The rats of this species feed entirely on the weeds growing round about their burrows, and they can be seen feeding in this manner even by day. They are never found in the rice fields, nor have stores of rice plants ever been found in their burrows. They are in fact, quite harmless from a farmer's point of view.

Hutton's Mole-Rat. *Nesokia huttoni.*

The other two common species of field rats in Lower Sind both belong to the sub-family *Murinæ*, or in other words to the large class of bandicoots. The genera *Gunomys* and *Nesokia* have only been recently separated on the basis (1) of the length of the palatal foramina,—this being long (8 mm.) in *Gunomys* and short (5 mm.) in *Nesokia*, and (2) of the number of mammæ, the genus *Gunomys* being multimammate (16 to 18 mammæ) while *Nesokia* has only 8 mammæ. Both are mole rats living normally underground, but the species occurring in Sind have very different habits.

Hutton's Mole Rat, *Nesokia huttoni*, is smaller than the Sind Mole-Rat (*Gunomys sindicus*) to be described later. Its range of length of the head and body is defined by Wroughton as being under 225 mm. but actual samples found in Sind are far smaller than this. Two adults gave the following measurements :—

	I	II
	mm.	mm.
Head and Body length	135	155
Tail length	90	112
Length of Hind Leg without claws	29	29
Ear length, from base	26	17

This species has very soft fur, and is ochraceous in colour fading to greyish-white on the belly. The fore and hind legs and tail are flesh coloured. The ears are fairly small and almost naked. The tail is short not more, or only very slightly more, than two-thirds of the length of head and body together. It is slender and covered with minute hairs. The adults weigh about four ounces. The number of young per litter does not, in our experience, exceed eight.

In disposition, the rats of this species are very variable. When kept in captivity some individuals are violent and bite at all parts of the cage in which they are confined, while others are quiet and submissive.

The burrows of this species are found in and round moist grassy areas during the dry weather and in the embankments of rice fields during the inundation season extending into the rice fields themselves as the water retires. They are very long (*see* Fig. 2) sometimes extending to forty or fifty feet. They are very much branched, but the communication between the

branches and the original burrow is generally closed. They have usually two to three openings all of which are closed with heaps of loose soil throughout the year. The inside of the burrows is not very clean, loose soil lying about everywhere. Sometimes the passage of the burrow is so completely packed up with soil that it is hard even to trace out its course. Nests are found in the burrows. When the water either in swampy areas or in rice fields dries up, the rats extend their burrows into these areas and use them until the next inundation compels them to withdraw to the portions in the higher ground. When the burrows are opened up, the rats, *Nesokia huttoni*, stick to them to the last and do not run away.

Rats of this species usually do not leave the burrows for quite long periods, and feed on the roots of grasses, *from the inside of the burrows*. The lines of the burrows can in fact often be followed in grass areas, from above ground by the withering of lines of grasses whose roots have been eaten. Their principal food appears to consist of the roots of *dab* grass (*Eragrostis cynosurioides*) as has been ascertained both by examination of their stomach contents and of the grass above their burrows. The search for the roots they require for food accounts for the great length of their burrows.

The Sind Mole-Rat. *Gunomys sindicus*.

The Sind Mole-Rat, *Gunomys sindicus*, which is the really serious injurious field rat in Lower Sind, is altogether a larger animal than either of the two others already described. Its range of length of the head and body is defined by Wroughton as being less than 200 mm., and adult examples actually measured in Sind gave the following figures :—

	I	II
	mm.	mm.
Head and Body length	190	198
Tail length	160	165
Length of Hind Legs without claws ...	37	34
Ear length, from base	24	24

This species has coarse and harsh fur, intermixed with a certain number of longer and coarser hairs scattered over the back and flanks. The colour is very variable, but the general appearance above is of mingled buff and black, fading into greyish-white on the belly. The fore and hind legs and tail are flesh coloured. The ears are large and appear almost naked, though they are really covered with very fine soft fur. The tail is long, slender and almost naked. The minute hairs with which it is clothed are visible with difficulty.

The females have normally eight pairs of mammæ, two pairs on the chest, two pairs on the inguinal region, and the remaining four pairs on the sides of the abdomen. But variations in the number and arrangement frequently occur. The number varies from fourteen to eighteen, and these are not always arranged in pairs, there being often two to three more teats on the left side than on the right.

Full-sized adults weigh about eight ounces. The rats of this species breed throughout the year. In October and November, however, the litters are very large, varying from fourteen to eighteen per litter. During the rest of the year, the number varies from five to ten. The young, when just born, are 35 mm. in length (head and body) and weigh from three to five grammes. They are born blind and naked, and are pink in colour. The eyes open after about a fortnight, and the young begin freely to leave the nest after about a month. Young rats of this species up to 134 mm. in length (head and body) have been sometimes found with the mother, and sometimes living independently.

The Sind Mole-Rats are very active and difficult to catch, and are fierce and have been even known to attack a man. They can usually be kept in confinement and will breed under these conditions. Though normally living underground they are neat and cleanly in their habits, cleaning dirt from their fur with the fore feet and tongue.

The burrows of *Gunomys sindicus* are found in exactly similar situations to those already described for Hutton's Mole-Rat, but they are much more migratory than the latter. It may be stated that the normal living and breeding places are round the edges of grassy areas which are flooded during the inundation season, known as *dhands* in Sind. The openings of the burrows are usually situated under bushes or in high grass. In July or August, when

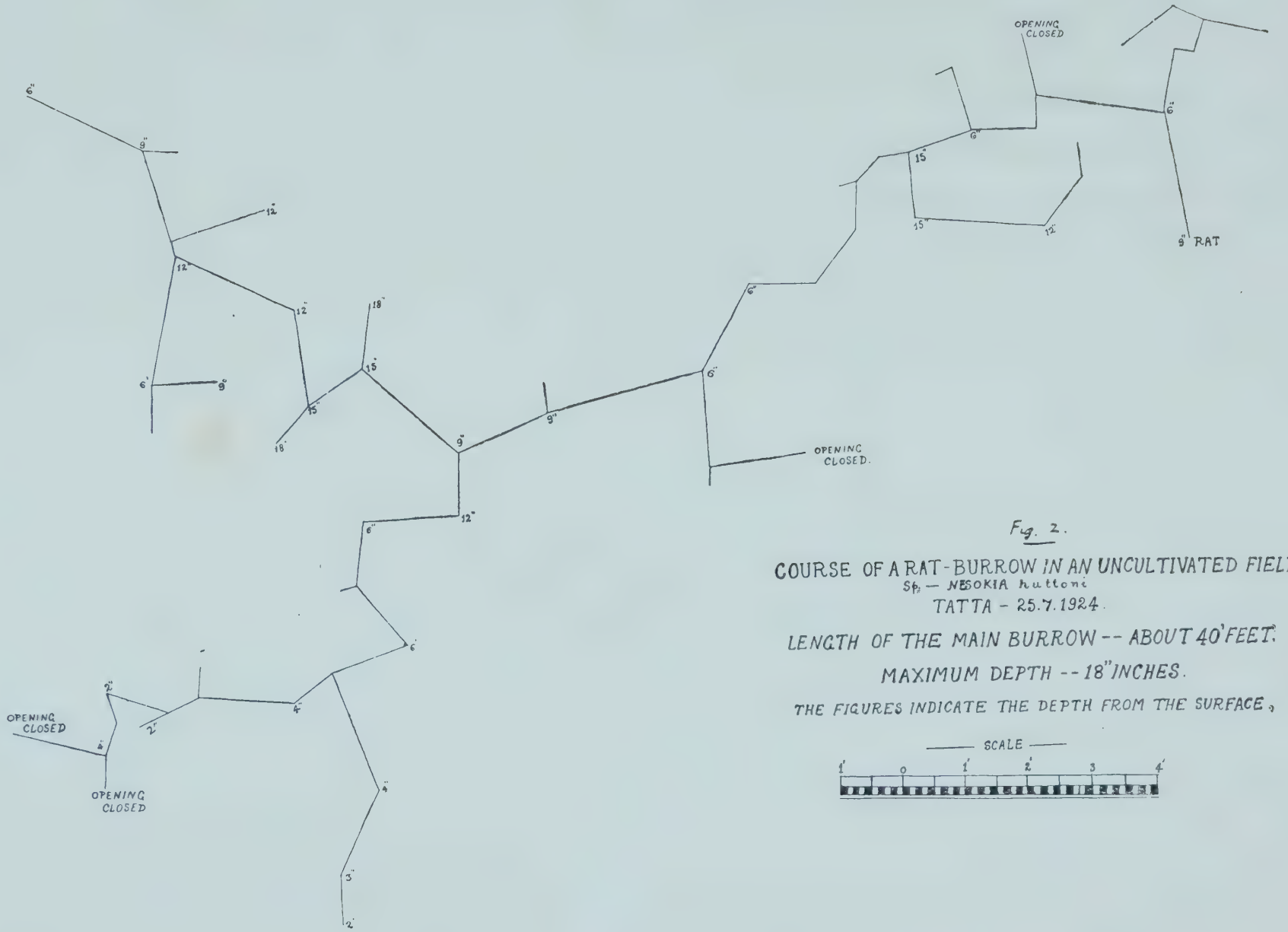


Fig. 2.

COURSE OF A RAT-BURROW IN AN UNCULTIVATED FIELD.
Sp. — NESOKIA huttoni
TATTA - 25.7.1924.

LENGTH OF THE MAIN BURROW -- ABOUT 40 FEET.

MAXIMUM DEPTH -- 18" INCHES.

THE FIGURES INDICATE THE DEPTH FROM THE SURFACE.

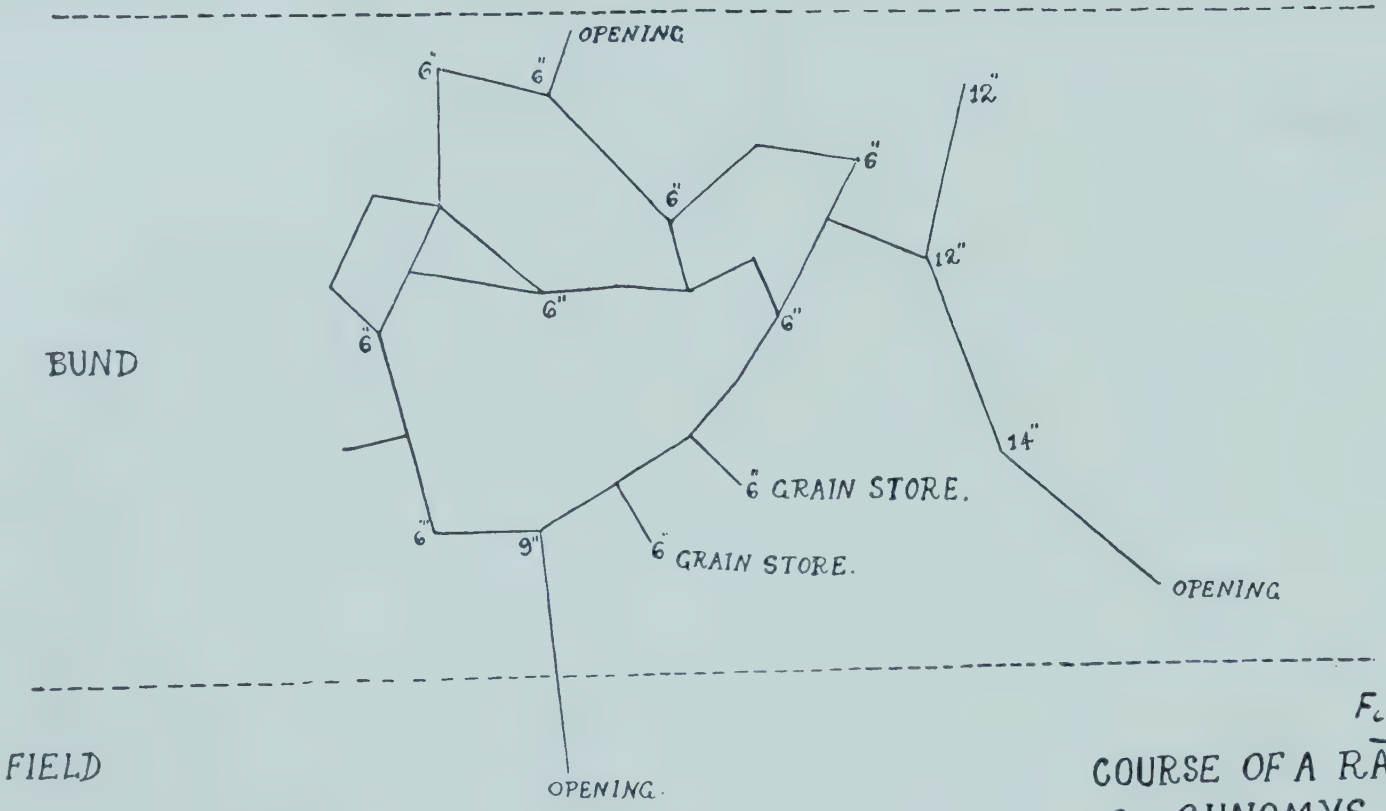


Fig. 3.

COURSE OF A RAT-BURROW IN BUND.

Sp. GUNOMYS sindicus.

HALAYA. 3.11.1924.

LENGTH OF THE MAIN BURROW – 13' FEET, 9" INCHES.

MAXIMUM DEPTH – 14" INCHES.

THE FIGURES INDICATE THE DEPTH FROM THE SURFACE.

SCALE.



the lower lands are flooded and the rice crops offer attractive food, they leave these grassy areas and turn their attention to the embankments of the rice fields. To these rice areas they keep pouring in throughout the season, and there is always more damage from rats in the areas which abound with *dhands*. When the water falls in the rice fields they extend their burrows into the fields themselves,—and after the crop is harvested and the rice which they have stored is exhausted, they again migrate to the grassy areas, often to considerable distances.

The burrows in the rice areas occur, therefore, both in the embankments and in the fields, but when there is water standing in the fields, they restrict themselves to the embankments. When both the fields and the embankments are submerged, as occasionally happens, they form nests on the tops of the rice plants above the water, but whether these are merely temporary resting places is not known.

The burrows of this species are short, but connect extensively with one another (*see* Fig. 3), especially when the rats live within the embankments. They then occupy a length of two to ten feet. Each burrow has three to four openings, which are generally found open, and a large heap of soil is found outside one or two of the openings. Balls of excreta are found mixed with these heaps of soil. There is no loose soil lying anywhere in the burrow. When the soil is very wet, and when there is plenty of grass or rice growing, the rats construct, inside their burrows, two or three nests either of grass or rice straw. Outside the burrow, distinct runways through dense vegetation to the feeding grounds of the rats are frequently found and it is under such safe cover that they move about in search of food. Though the rats of this species are nocturnal in their habits, yet they can sometimes be seen outside by day, especially at harvest time, under cover of grass.

When the water in the rice fields dries up, the rats leave their burrows in the embankments and dig fresh burrows in the fields themselves. Such burrows are longer than those in the embankments, and in these they store grain, sometimes along the main burrow, and sometimes in special chambers. After this store is finished, the general migration from the rice areas to the grassy lands (*dhands*) begins, where they dig fresh burrows, and these they occupy until the next inundation season.

Though the Sind Mole-rat lives normally in dry land, it is capable of swimming. Medium-sized adults when kept in water twelve inches deep in glass jars were able to maintain themselves without any support from forty to sixty hours. They are always able to dive, and in face of any danger they jump into water and dive or swim away. A high flood, however, destroys enormous numbers of these rats, and is probably the main natural agency in keeping down their numbers.

Food and Habits of the Sind Mole-Rat

In nature, the Sind Mole-rats have been noted to feed on two different classes of material. On the one hand they take, when they can obtain them, rice plants in various stages, and the earheads of the *bajri* crop (*Pennisetum typhoideum*) : on the other hand they eat the roots and tubers of certain grasses and sedges.

So far as the rice plant is concerned, it is eaten chiefly in three stages. In August when the crop has grown to a height of eighteen inches to two feet, the rats cut off the plants at the bottom, to feed on the lower sweet pulpy portion of the stem. It is in these days that the rats, probably for the purpose of being near enough to their food supply, construct temporary nests on the top of the rice plants—especially in submerged fields—made of rice plants cut and twisted together. The damage to the rice fields at this stage is generally in the form of patches all over the fields, and in years of rat plagues these patches extend over large areas. Usually the damage is not so serious as it looks, as tillering takes place, and the plants still mature though a little later than the general crop.

The second stage of the growth of the rice plant when it appears particularly attractive to the Sind Mole-rat is when the grain in the earheads is soft and milky. The rats then either climb up the rice plants or bend them over, and suck the milky pulp from the earheads which consequently dry up. A far more serious type of damage is done, however, in the third stage when the grain has fully ripened. The rats then eat the grain, leaving only the outer hulls,

and in order to do so they cut off the earheads and store them in large quantities in their burrows. The burrows, in fact, if dug at this time of year (October or November) show large numbers of earheads stored, sometimes in special chambers and sometimes in the main burrows. More than six hundred earheads were counted in some of the burrows, and even then, more were being collected. Much is eaten, much is wasted, and the store is used up, ordinarily, by December in each year. This cutting off, storing, and eating the mature or nearly mature earheads represents the chief damage done by the rats. In 1925, a large number of fields in the Tatta, Sujawal and Shah Bunder talukas of the Karachi District were examined, and about 12½ per cent of the earheads had been removed in this manner. This was not a 'plague year' but probably represents the normal amount of damage in much of the Indus Delta. If we take it as such, and count a normal crop as 1,000 lbs. per acre of paddy, worth 25 lbs. per rupee—this damage would mean over twenty-three lakhs of rupees damage per annum.

Other *crops* are only eaten to a limited extent. *Bajri* grown in the inundation season, and wheat grown in the cold weather are also taken in some years, but not to anything like the same extent. Oilseeds (rape, mustard, etc.) and pulses grown in the cold weather are almost free from the trouble.

The other main food of the Sind Mole-rat, used chiefly during its annual sojourn in the grassy areas, consists of the roots and tubers of certain grasses and sedges, which are exceedingly common there. The chief of these are (1) the roots of *dab* grass (*Eragrostis cynosurioides*) (2) the roots and tubers of *dheer* (*Scirpus subulatus*) and *kal* (*Scirpus maritimus*). These materials supply the chief food during the portion of the year when rice is not available.

In order to try and find the real preferences of the Sind Mole-rat, in the matter of food, a number of adult rats were kept in cages and fed on various materials. Small to medium-sized adults or nearly adult rats, weighing from four to five ounces each were taken, and kept for two days or so in the cages to accustom them to the surroundings with a sufficient supply of water. Weighed quantities of various foods were placed in the cages, and the amount left after 24 hours was again weighed. The difference between the amount given, and the amount remaining after 24 hours, indicated the amount consumed by the rat. A number of tests were made with each kind of material. Healthy rats only were employed: if they became sick, they were not used again.

The average quantity consumed in 24 hours by small to medium-sized rats was as follows:—

Green Bananas	...	...	10·7 gms.	
Ripe Bananas	...	...	22·0 ,,	
Green *guvar*[1] pods	...	..	1·3 ,,	
Turi (*Lufa acutangula*)	...	...	25·3 ,,	
Roots of *dab* grass	...	...	10·9 ,,	
Uncooked wheat flour wetted with water		...	9·0 ,,	
Cooked wheat flour wetted with water		...	14·0 ,,	
Uncooked wetted *bajri* flour	...	...	9·6 ,,	
Cooked wetted *bajri* flour	...	...	13 1 ,,	
Uncooked wetted rice flour	...	...	12·5 ,,	
Cooked wetted rice flour	...	...	15·0 ,,	
Uncooked wetted *gram*[2] flour	...	...	4·0 ,,	
Cooked wetted *gram* flour	...	...	14·2 ,,	
Uncooked wetted wheat bran	...	...	8·6 ,,	
Cooked wetted wheat bran	...	...	10·9 ,,	
Dry gram	...	...	1·7 ,,	
Gram soaked in water for 24 hours		...	8·1 ,,	
Earheads of rice	...	...	6·7 ,,	leaving all (hulls)
Earheads of *Bajri*	...	...	10·3 ,,	
Earheads of *Jowar* (*Sorghum*)	...	...	5·8 ,,	
Dry Copra (Cocoanut)	...	...	1 1 ,,	
Dry Fish	...	...	Nil	
Green rice plants	...	...	6·6 ,,	(only the lower portion of stems eaten)

[1] Guvar, *Cyamopsis psoralioides*. [2] Gram, *Cicer arietinum*.

Some of the tests were repeated with larger rats (6 ounces), but using the same method. The result was as follows :—

Roots of *dab* grass	...	...	24·4 gms.
Tubers of *kal* (*Scirpus maritimus*)		...	42·7 ,,
Unhusked rice	...	...	14·9 ,, (leaving all hulls)
Uncooked *bajri* flour	...	...	10·8 gms.
Cooked *bajri* flour	...	...	34·4 ,,
Dry whole wheat	...	...	4·0 ,,
Dry crushed wheat		...	8·3 ,,
Crushed wheat, wetted with 25 per cent water	...	...	12·8 gms. (dry wheat).

It will be noticed from all these figures that the roots and tubers of grasses are very highly relished, that grain flours of all kinds are eaten readily, and are preferred when cooked and that rice is only eaten after removing the hulls. Plantains are very much relished, but green *guvar* pods are not liked. Fish is not touched at all. Only the lower portions of the stems of green rice plants were eaten.

As it was desirable to know whether foods could be made more attractive, some of these foods were mixed with *gul* (raw sugar), with cocoanut oil, and with aniseed oil. These were all mixed with rice flour, or wheat bran,—but in no case did the addition cause the rats to consume more of the food used. The following figures indicate the results :—

Quantity consumed by one rat in 24 hours.

1	(*a*)	Uncooked rice alone	... ...	12·5 gms.
	(*b*)	Uncooked rice with *gul*	... ...	8·4 ,,
2	(*a*)	Cooked wheat bran alone	... ...	10·9 ,,
	(*b*)	Cooked wheat bran with *gul*	... ...	9·0 ,,
3	(*a*)	Uncooked rice flour alone	... ...	12·5 ,,
	(*b*)	Uncooked rice flour, with cocoanut oil	...	10·4 ,,
4	(*a*)	Uncooked rice flour alone	.. ..	12·5 ,,
	(*b*)	Uncooked rice flour with aniseed oil	...	10·0 ,,

Methods of Control of the Sind Mole-Rat

In Lower Sind, the Sind Mole-rats always do extensive though variable damage. Some years they are a veritable plague and in most seasons, this is the case in some parts of the area. Probably the main natural means of control is the prevalence of floods. Though these rats are good swimmers, yet a high flood by filling their burrows with water, does destroy a large number for in these times it is only the very high land which remains as a refuge. The fact of the variability of the damage from year to year, apparently without reason, leads to the idea that a rat plague is a scourge of God against which little or nothing can be done. This idea prevails very widely among the cultivators of the Indus Delta.

When the pest becomes really serious, many people *do*, however, have recourse to digging out the rats in the embankments and there are even special rat *shikaris* employed, who are very skilful in digging out and killing rats. The Sind Mole-rat is somewhat difficult to deal with, as it is easily alarmed and runs away at the least provocation. But the *shikaris*, who have made this their profession, are able, in bad attacks, to catch and kill sixty or seventy rats per day, and are paid eight to twelve annas per hundred rat-tails produced. As the number of rats decreases, the rate of pay rises, till it may go up to Rs. 2 to Rs. 3 per hundred tails.

A method of digging has been recently adopted in the Tatta taluka, by which all openings of the burrow were closed except one, and a fishing net was placed over the remaining opening. As the *Gunomys* rat is easily alarmed, it flees when digging is begun, and is caught and killed in the net. Dogs are some times used, too, in connection with digging.

But, at the best, the digging out of rat holes is an expensive and unsatisfactory method. Long burrows are usually avoided by the *shikaris*, as being too much trouble. The embankments are often badly spoiled by the digging operations and cost a good deal to repair. Many of the rats killed are the harmless *Nesokia*

huttoni instead of the injurious *Gunomys sindicus*. And, as new rats are continually moving into the rice area, a few field may easily be re-infected after all the trouble has been taken.

Two methods of destroying the Sind Mole-rat on a large scale have been tried. The first has been by poisoning, which has not proved applicable on a large scale : the second is by fumigation of the burrows which under conditions which can now be defined, seems to be practicable and efficient as a method of controlling the rats.

Control by Poison Baits

In the experiments on poisoning, the best medium for conveying the poison was found to be cooked *bajri* flour. This was as attractive as any available material, and was mixed with (1) strychnine hydrochloride, (2) barium carbonate, (3) white arsenic, (4) plaster of Paris, and (5) a proprietary phosphorus preparation known as ' Farmers ' Vermin Destroyer '. The last two of these proved entirely useless : On the other hand, effective results were obtained with the other poisons.

With strychnine hydrochloride, one rat died within half an hour after taking cooked *bajri* flour containing 0·025 grains of the poison : another died within 12 hours after taking bait containing 0·12 grains of the poison. With barium carbonate the minimum effective dose was 1·0 grain of the poison, contained in 5 grammes of *bajri* flour. In this case the rat died within 12 hours. Using white arsenic, cooked *bajri* flour containing 0·05 grains of the poison was effective within 12 hours.

All the above tests were made with 4 to 5 ounce adult rats. Further trials were then made with larger rats weighing 6 ounces. Again strychnine hydrochloride was found to be effective within 12 hours when the rat consumed *bajri* flour containing 0·1 grain of the poison. Barium carbonate caused the death of the rat within 48 hours when flour containing 1·2 grains of the poison was taken, and within 15 hours when 2·4 grains of the poison was consumed. In the case of white arsenic, 0·2 grains of the poison killed the rat in 36 hours and 0·5 grains in 12 hours.

When tested in the field the following method was adopted : Baits of cooked *bajri* flour or other media, 5 to 8 grammes in weight were mixed with adequate doses of the poison and placed near one of the openings of the burrows in the evening. They were examined next morning, and when the baits had been touched, the burrows were dug out to see whether the rat was dead. Four cases occur.

1. The bait had been partly or wholly eaten, and on excavation a dead rat was found in the burrow.
2. The bait had been partly or wholly eaten, and on excavation no rat was found in the burrow.
3. The bait was untouched, and no sign of a rat's activities.
4. The bait was untouched, but had been dragged inside the burrow, and there was only a living rat in the burrow.

The first case means success : the second has been counted as success, for it is probable that the rat had died away from the burrow : in the third case the burrow is evidently uninhabited and so these cases are excluded from the list of tests made : and in the last case, the rat refused the bait or was unaffected by it, and the result was a failure. The percentage of success was calculated by the proportion of cases 1 and 2 to the total of cases 1, 2 and 4.

The results with barium carbonate and white arsenic were extremely poor, as follows :—

A.—*Barium Carbonate* (3 to 4 grains per bait).

1.	December 1924.	*Medium*-Cooked *bajri* flour (16 baits) ...	12 5 per cent successful.
2.	February 1925.	*Medium*-crushed wheat (25 baits) ...	12·0 ,,

B.—*White Arsenic* (1 grain per bait).

1.	January 1925.	*Medium*-cooked *bajri* flour (30 baits) ...	43 ,,
2.	February 1925.	*Medium* crushed wheat (40 baits) ...	10 ,,

Strychnine hydrochloride was much more effective, as follows :—

C.—*Strychnine hydrochloride* (0·3 to 0·5 grain per bait).

1.	December 1924.	*Medium*-cooked *bajri* flour (14 baits) ...	43 per cent. successful.	
2.	December 1924.	*Medium*, whole wheat (45 baits) ...	67	,,
3.	January 1925.	*Medium*-crushed wheat (40 baits) ...	60	,,
4.	February 1925.	*Medium*-crushed wheat (57 baits) ...	39	,,
5	March 1925.	*Medium*-crushed wheat (23 baits) ...	22	,,
6.	March 1925.	*Medium*-boiled rice (20 baits) ...	20	,,

Even in the case of the last poison, the results are not, however, very promising. With a migrating pest like the Sind Mole-rat, partial destruction of the pest in this manner is hardly what is wanted, and as attempts at fumigation had more promise, further attempts in the direction of using poison baits were given up.

Control by Fumigation

As it was shown in the early part of this investigation that the burrows of the Sind Mole-rat, as they are found in the embankments of the rice fields during the inundation season, are comparatively short and free from obstructions, there seemed a possibility that the rats could be killed by fumigating the burrows with lethal gases. Previous attempts using carbon bisulphide vapour as the fumigant, in the longer burrows found in the cold weather (November and December 1920) had proved very ineffective, but as soon as it was realized that the only time for fumigating the burrows was during the inundation season, almost complete success was obtained.

The method used was first to pump smoke (made by the mixed vapours of hydrochloric acid and ammonia) into a burrow, close all openings where smoke comes out, by soil,—and then pump in the fumigant. The machine used for the purpose was the '*Suddeth Rabbit Fumigator*' obtained from Australia. Carbon bisulphide or petrol, or a mixture of the two was used as a fumigant in all these tests in 1925. The amount used varied from one pound per nine burrows, to one pound per 40 burrows, and the latter quantity was found quite effective *at the proper season*. The actual quantities used and the percentage of success was as follows :—

Date	Fumigant	Number of Burrows per 1 lb. of fumigant	Percentage of success per cent
August 1925	Carbon bisulphide	9	100
,,	,,	20	100
,,	,,	40	100
September 1925	,,	40	100
October 1925	,,	40	100
November 1925	,,	40	25
December 1925	,,	23	33
January 1926	,,	20	30
October 1925	Petrol	30	18
November 1925	,,	15	Nil.
October 1925	Petrol and Carbon bisulphide (1 : 1)	15	83
November 1925	,, (2 : 1)	34	32
December 1925	,,	15	8

The results seem clear. Up to October, carbon bisulphide seems a perfectly effective fumigant, when applied at the rate of one pound per 40 burrows.

An attempt was made to apply this method of fumigation with carbon bisulphide in 1925 on an area of 250 acres in a badly affected area in the Shah Bunder taluka, during the inundation season. The rats were found chiefly in the embankments, which were covered with thick tall grass—thus causing

considerable difficulty in finding the burrows. The area was gone over with the machine,—smoke followed by fumigant,—and all the rats destroyed, as was made clear by digging out a number of the burrows. Then the embankments were re-infested with rats from the outside, and the treatment was repeated. The whole area was in fact, gone over four or five times, and 2,500 rats were destroyed. The cost for material came from 8 to 10 annas per acre.

When the experiments had reached this stage, I was compelled to leave Sind and further work was placed in other hands. I have been allowed, however, to utilize the results obtained in 1926,—when the work of rat extermination was carried out on a much larger scale, and a new method of fumigation introduced, which bids fair to give more widely applicable results than those previously described.

The results of 1925 had, however, been so promising that it was decided to deal with about 3,200 acres of badly affected country in 1926. It was clear that if fumigation was to be successful, it would have to be done between August and October, whatever fumigant was used. It was originally intended that carbon bisulphide should be exclusively used for the purpose, but just when the work was about to begin, attention was drawn to the probability that even better results might be obtained by the use of calcium cyanide in very fine dust, which could be pumped into the burrows exactly like a vapour. This material is now available in large quantities at a moderate price, and suitable cheap pumps for blowing the dust into the burrows are also obtainable. Preliminary experiments, near, Tatta, were, in fact, so promising that it was determined to use this material on a large scale.

In carrying out these large scale tests, two centres were taken in both of which the rat attack promised to be very serious in 1926, and altogether 3,463 acres were treated either with carbon bisulphide or with calcium cyanide dust (A dust). All the land was gone over three times, and 423 acres in Tando Mahomed Khan was gone over four times. The total quantity of carbon bisulphide used was 1 lb. 10 ozs. per 100 burrows and of calcium cyanide dust was half a pound per 100 burrows.

The following table shows the details of the treatment. It may be noted that the carbon bisulphide costs Rs. 2-8-0 per pound, and the calcium cyanide dust Rs. 1-8-0 per pound. Both these prices would be very much reduced if the use of the method became general.

Place	Material used	Area treated in acres	No. of burrows treated	Cost of material & labour per acre. Rs.	Total cost per acre Rs.
1. Shahbunder.	Carbon bisulphide	720	12,431	1 1 0	2 2 0
2. Shahbunder.	Calcium cyanide dust.	1,040	24,960	0 6 0	0 12 0
3. Tando Mahomed Khan	Carbon bisulphide.	423	12,089	1 11 1	3 6 2
4. Tando Mahomed Khan	Calcium cyanide dust.	1,280	22,874	0 5 8	0 11 4

The treatment was completely successful with both materials, but the use of Calcium cyanide dust is not only much cheaper, but also is much simple to apply. It appears clear, in fact, that by an expenditure not exceeding 12 annas per acre, this rat pest, which as has been shown above, causes an annual loss of crop which amounts to between twenty and thirty lakhs of rupees, can be controlled.

GAME PRESERVATION IN THE NILGIRIS

BY

MAJOR E. G. PHYTHIAN-ADAMS, I.A. (RETD.)

The Nilgiri Game Association was formed in 1879, and is therefore one of the oldest societies for Game Preservation in India.

The area under its control includes not only the whole of the Nilgiri District, but also parts of Coimbatore and Malabar. A detailed physical description of the country is unnecessary, and it will suffice to divide it into (1) upland; (2) slopes; and (3) low country. (1) The upland consists of the Nilgiri plateau at an average elevation of 6,500′, open rolling downs alternating with wooded sholas often of considerable extent. (2) The slopes, generally grassy or with light jungle, run down more or less precipitously to the low country. On the west are the famous cliffs of the Kundahs. (3) The low country includes the Nilgiri Wynaad at an average elevation of 3,000′ and the area between the slopes and the Moyar and Bhavani rivers running down to little more than 1,000′ above sea-level. The jungle varies from heavy tree to light thorny scrub.

The mass of the Nilgiri plateau intercepts the monsoon currents and accordingly one side receives heavy rain from the south-west monsoon while the other obtains little except from the north-east. This climatic variation considerably affects both the nesting seasons of birds and the times when the deer, more especially chital, may be found in hard horn. At the time of the formation of the Association in 1879 as the result of considerable Press agitation, big game was fast approaching extinction on the plateau. The butchers of that period knew no restriction of age, sex, or season, and slaughtered alike does, fawns, and stags in velvet. To anyone who thinks this picture overdrawn, a persual is recommended of the articles entitled 'Game,' published in the *South Indian Observer* in 1876, by 'Hawkeye,' the late General Hamilton, to whom the thanks of all sportsmen are due. Owing largely to his efforts, the Madras Government passed 'the Nilgiris Game and Fish Preservation Act of 1879,' which with minor modifications has been in force ever since.

The Act provides for close seasons, protection of females and immature animals, etc., on Government lands only, and vests in the Collector of the District very considerable powers regarding the conditions under which a licence to shoot may be issued. The Collector is assisted by the D. F. O. as Honorary Secretary, and by the Committee of the N. G. A. At the present time a season

shooting licence costs Rs. 50, and entitles the holder to shoot the following head of mature game :—

Sambur	... 2	Jungle-sheep	... 6
Spotted deer	... 3	Ibex	... 1
Blackbuck	... 1	Bison	... 1
		Four-horned antelope	... 1

while a monthly licence costing Rs. 30 entitles the holder to :—

Sambur	... 1	Bison or Ibex	... 1
Spotted deer	... 1	Blackbuck or four-horned antelope	... 1
Jungle-sheep	... 3		

Mature heads are defined as :—

Sambur	... 30″	Spotted deer	... 28″
Blackbuck	... 14″	Ibex	... 13″

Bison 33″ span, or 18″ girth, or 4″ of corrugation.

Stringent penalties are imposed for shooting females or immature heads. All fines however have to be credited to Government, and are not allowed to swell the funds of the N. G. A.

The close season runs from July 1 to October 31 for big game, and from March 1 to September 15 for small game; there is no separate licence for the latter. On an average about eighty season and twenty monthly licences are issued. Visitors pay the same fees as residents.

Taking in order the various big game of the area :—

(1) *Sambur.*—Are now numerous all over the plateau, slopes, and low country, but really good heads are very scarce, and even those considered shootable (30″) are not numerous. The hinds outnumber the stags on an average by eight to one, and need thinning, but the difficulties in the way of this are obvious. The total absence of lime on the Nilgiris is no doubt chiefly to blame for the small size of the heads but another contributing cause is undoubtedly the shooting off of the best stags year after year, leaving to breed chiefly immature animals and those past their prime. All old stags 'going back' should be shot off.

The record head for the Nilgiris is only 42″ shot many years ago, and it does not appear that one over 38″ has been obtained for some time. During the past six years an average of twenty-eight stags has been shot annually.

(2) *Spotted Deer.*—Very numerous in the low country, but much persecuted by wild dogs and by patta-land shooters. The heads are good running up to 38″, but are generally thinner than those in the C. P. The average for the last six years is twenty-seven buck annually.

(3) *Bison.*—Have increased considerably in the low country, some of the herds numbering up to thirty. Good heads are however scarce and the average number shot in the last six years is only seven annually, the best recorded head having a span of 41″.

(4) *Ibex.*—Nilgiri Tahr, locally known as Ibex, were nearly extinct in 1879 but thanks to careful protection have now increased very considerably, and the total of the herds in the Kundahs cannot now fall much short of 400. In 1925 the writer saw a single herd of over eighty, nearly half of which were kids. After such a long

period of protection it might be expected that the old bucks (saddle-backs) would carry fine heads, but of the *total* of eight shot in the last six years, the best measures only $15\frac{1}{4}''$. The does outnumber the bucks by some 20 to 1, and there is no satisfactory explanation for such disproportion. Ibex suffer considerably from the depredations of panthers and, though to a less degree, from poaching Kurrumbas on the Bhavani slopes.

(5) *Blackbuck.*—Were closed to shooting from 1923 to 1926 and are still not numerous, but sufficiently so to allow the inclusion of one on the licence for those who care to shoot so poor a trophy. They seldom measure over 17″ and are considerably smaller in build than up-country buck.

(6) *Jungle-sheep.*—As the Muntjac is locally called—are sufficiently numerous and call for no remarks. Fifty-two are shot annually on an average.

(7) *Four-horned Antelope.*—Are scarce, and only four have been shot in the last six years. It may be of interest to note that the variety with two horns only is generally found here. In old books it is termed the 'Mountain Antelope.'

(8) *Nilghai.*—Are rare in the area and are strictly protected.

(9) *Tiger, Panther and Bear.*—Are not protected and call for few remarks. The average numbers shot annually during the past six years were 13, 29 and 6 respectively. Chance-met tigers occur more frequently on the plateau than in most other parts of India. The writer had the good fortune to meet a family party of three on the main bridle-path in the Kundahs on November 1 last, and the late General Hamilton once saw no less than five together in the same locality.

The destruction of panthers has resulted in a great increase in the numbers of wild pig which did so much damage to cultivation that in 1921 Government found it necessary to give a reward for their destruction. After some 1,350 had been killed the reward was stopped in 1924.

(10) *Wild Dogs.*—Though not strictly speaking game, these play an important part in Game Preservation. Up till 1923 a reward of Rs. 25 was paid for every wild dog killed in the area, of which the N. G. A. gave Rs. 15, Government contributing the balance. The results were satisfactory in that some forty to fifty were destroyed annually. Unfortunately the adjoining districts did not co-operate, and skins of dogs shot outside the area were brought in in such increasing numbers that the N. G. A. in 1923 were forced from lack of funds to discontinue the reward. At the same time Government in a fit of economy stopped their contribution also. There is no doubt that the reward of Rs. 25 was too high, but to stop it altogether was a very short-sighted policy and resulted in a great increase in the numbers of wild dogs. The spotted deer and sambur in the low country suffered severely in consequence, some parts being temporarily denuded of all game, while several packs even made their way up on to the plateau, which had been free of them for some years. In 1926 it was decided to renew the N. G. A. reward of Rs. 10 and to address Government for assistance in the matter.

So far as this area is concerned there is as yet no definite evidence of more than one type of wild dog, though a smaller and fiercer variety is said to occur just inside the Mysore boundary. This however still remains to be confirmed.

Small Game.—The game birds of the area include Snipe, Woodcock, Nilgiri Wood-pigeon, Grey Jungle-fowl, Spurfowl (red and painted), Peafowl, Sandgrouse (painted), Grey Partridge and several varieties of Quail, but compared with other districts, the shooting must be considered distinctly poor. A bag of a dozen head, on the plateau at any rate, is as much as one gun can expect in a day, and he will have to shoot straight to get even that.

Sisi and Chikor were imported and turned down some years ago, but no trace of them can now be found. An experiment is shortly being made with Burmese Silver Pheasants, and it is to be hoped that this will meet with more success. Grey Jungle-fowl have been brought up on to the plateau from the low country from time to time, certain sholas where they are released being closed to all beating, but the majority probably soon find their way down again.

In 1926 the Nilgiri Game Association decided to reintroduce rewards for the destruction of vermin, the scale being :

Wild Cats and Red Mongooses, Re. 1 each.

Hawks, Crow-pheasants, Harriers and Eagle-owls, As. 8 each.

The shooting of Jungle-hens is not permitted after January 1 each year, and shooting would improve if they were protected altogether for several years, at any rate on the upper plateau round Ootacamund.

Poaching is inevitable and all that can be done is to mitigate the evil as far as possible. The N.G.A. has for many years and at considerable expense maintained a staff of seventeen game watchers, but as they were found to be quite useless, they were abolished in 1926, and their duties taken over by ordinary Forest Guards, a special sum being set aside by the N. G. A. for rewards for reporting cases. The N. G. A. is much hampered by the amount of private Patta land in the area, over which it has no control, and on which shooting takes place without restriction throughout the year. Since the revision of the Indian Arms Act a few years ago the number of licensed weapons has increased enormously, and there is, unfortunately no doubt that poaching into Reserved Forests is far more comon than it used to be. What is needed is an Act to protect the females of deer at all times, and game birds during the nesting-season equally on private as on public land.

The Forest Rangers and their assistants in this district now receive free shooting licences, and if they will fully realize their responsibilities in the matter of Game Preservation, much might be effected.

Certain areas on the plateau are closed to shooting either big or small game, and others to beating, and it is proposed to close next year to all shooting a considerable area in the centre of the plateau to acclimatize imported Jungle-fowl and Burmese Pheasants. For many years the large tract on the west of the

plateau known as the Kundahs has been closed to all beating and small game shooting. It was re-opened this season, but there is no appreciable increase in the number or size of heads in the case of Sambur, nor in the number of small game. The Kundahs are uninhabited and seldom visited except by an occasional sportsman or by men grazing herds of cattle. Its southern edge is no doubt poached to a certain extent by the jungle Kurrumbas from the Bhavani Valley, but they do not penetrate far above the cliffs. The poor results obtained seem to show that a long period of protection in the same area is a mistake, and that closed areas should not be kept as such for more than a few years.

General.—The present condition of game in the area is satisfactory, but the greatly increased number of licensed and unlicensed weapons in the hands of Patta-land shooters renders necessary stricter supervision than formerly, and an Act to regulate the sale of big game throughout the year, with severe penalties for the use of a gun except by a licence-holder in person. Unless some such steps on the lines indicated are taken at an early date, the head of game in the area will diminish rapidly, and no longer afford alike to the resident and to the visitor the sport that it does at present.

LOVEDALE, NILGIRIS,
March 3, 1927.

SOME FURTHER NOTES ON THE SECOND EDITION OF THE FAUNA OF BRITISH INDIA—BIRDS, VOL. III

BY

CLAUD B. TICEHURST, M.A., M.R.C.S., M.B.O.U., F.R.G.S.

p. 2. *Irena puella.* Even at the present day the British Museum lacks sufficient material among many of the commonest Indian species to elucidate their moults and plumages, the old idea however that any species acquires its plumage by pigmentation without a moult has been discarded by practically every ornithologist in the world ; there has never been any proof that such a phenomenon can take place and a good deal of proof that such a thing is a physiological impossibility. An examination of the British Museum series however does show that first winter males resemble the adult female and by complete moult become adult the following spring. The juvenile of this well-known species appears to be unknown !

p. 6. *Oriolus o. oriolus.* I do not think there is any proof that this oriole winters in N.W. India at all, indeed the only record I can find is one from Karachi in September where it may be straggler at the seasonal migrations.

Many Indian orioles have longer wings than 142 mm. and I find a sexed series show ♂ 138–149, ♀ 132–146.

p. 24. *Saroglossa.* I cannot agree that an original error in spelling should be perpetuated, moreover it is not in accord with the International Rules to do so (Rule 19). The word is of course derived from the Greek *psar* (= a starling) cf. Psarisoma, etc. and Hodgson must have made a slip or else a printer's error crept in and it is on a par with Sturnopas*ter* altered to Sturnopas*tor* (p. 61).

p. 32. *Sturnus v. humii.* The description of the ' young birds ' plumage is not at all clear. Here by ' young birds ' is meant the first winter plumage and by ' nestling ' the juvenile plumage. In the description of the ' nestling ' plumage there is no mention made of white spots on the lower plumage nor of any buff spots on the upper plumage which we are told the ' young bird ' retains. As a matter of fact the first winter birds retain none of the juvenile or ' nestling ' dress, there being a complete moult, and in this dress are more profusely spotted on the under-parts than any other race of Starling. The breeding distribution is given as the Himalayas east to Nepal ; it is common enough in parts of Cashmere but it must be very local now-a-days in the Simla-Almora area ; at least there appear to be no records of it.

p. 33. *Sturnus v. minor.* The irides of females I shot were *bright gold* and not *white* ; a very striking and distinctive feature.

p. 34. *Sturnus v. poltaratzskii.* All races of Starling vary but the majority of this race have the ear coverts *purple*, *not green*, and is thus in contra-distinction to *v. vulgaris* ; a few, which I otherwise cannot differentiate, however have the ear coverts greenish.

p. 54. Fourth line from bottom ' nesting ' should be ' roosting '.

p. 56. Here as in many cases throughout the Fauna the terminology of the plumages varies. Sometimes by ' young birds ' juvenile plumage is meant, sometimes first winter plumage is meant ; sometimes by nestling the juvenile plumage is meant, sometimes the down plumage.

A few instances at random :—

' Young bird ' =juvenile.	' Young bird ' = 1st winter.	' Nestling ' =juvenile.
Acridotheres ginginianus.	*Sturnus humii.*	*Hirundo filifera.*
Motacilla citreola.	*Motacilla feldegg.*	*P. icteroides.*
Emberiza calandra.	*Emberiza stracheyi.*	*Emberiza arcuata.*
Alæmon alaudipes.	*Anthus cervinus.*	*Passer montanus.*

' Nestling ' = down plumage.

Motacilla cinerea.

The plumages of birds are difficult enough to understand but if the age-names of the plumages are not definitely fixed chaos is inevitable. ' Young bird ' is a thoroughly bad term as it means any bird which is not adult, ' nestling ' too is

a loose term and both have long been given up by most writers in favour of juvenile plumage and down plumage which are fixed plumages in the life cycle.

p. 66. Sub-family *Ploceinæ*. This is said to contain four Indian species ; it should be six.

p. 77. *Estrildinæ*. It is not quite correct to say that these have no spring moult. Many perhaps do but it is a question I have not been able to go into ; *Amandava amandava* however certainly has a spring (prenuptial) moult as I pointed out some years ago (Ibis 1922, p. 647).

p. 78. *Munia malacca*. On line 1 the type locality is fixed as Belgaum ; lower down it is fixed as Ceylon. Looseness in fixing type localities leads to endless trouble.

p. 88. *Uroloncha rufiventris*. Here is one more example of the infinality of nomenclature ; Mr. Baker renames the *Munia pectoralis* of Blyth as he considers this name is preoccupied by *Amadina pectoralis* of Gould ; this is quite correct if these two birds belong to the same genus, however Mr. Matthew's in his *Birds of Australia* puts Gould's bird in the genus *Heteromunia* and if his views are adopted, Blyth's name will stand as *Uroloncha pectoralis*.

p. 91. *Uroloncha punctulata*. This bird certainly occurs in the hill Punjab, Dharmsala, Kangra Valley, etc.

p. 96. *Amandava amandava*. It still seems to be unknown though I recorded the fact (Ibis., 1922, pp. 646-7) that this Munia has a non-breeding dress which somewhat resembles that of the female and into which it moults after breeding.

p. 101. *Perissospiza*. This genus is split off from *Mycerobas* on what appear to me to be very trivial characters, especially as these Grossbeaks do not form an unwieldy group which for convenience might be divided up. The differences between say *icteroides* and *melanoxanthus* seem to be no greater than between say *Corvus splendens* and *Corvus tibetanus*.

p. 104. *P. carneipes*. The bird which ranges from Baluchistan to N. W. Himalayas and Turkestan is I consider quite separable and should stand as *speculigera* (*B.N.H.S.*, xxxi. 4).

p. 117. *Hæmatospiza sipahi*. I cannot confirm that the female has a much shorter tail than the male as stated. I measure them as follows, ♂ 67–75, ♀ 66·5–71, a tail of 55 mm. is surely not fully grown ?

p. 122. *Propasser*. Here again it seems doubtful if this genus can be kept distinct from *Carpodacus* though it might be more convenient to do so. *P. rhodochlamys grandis* has the supercilium of a *Propasser* and the wing proportion of a *Carpodacus* ; again in *Carpodacus macgregori* and *trifasciatus* the proportion between the tarsal length and wing-tip length is equal, thus bridging the distinction.

p. 124. *P. thura blythi*. If *Propasser* and *Carpodacus* are both recognized then *blythi* cannot be used for this bird as it is antedated by *Propasser frontalis* of Blyth which is *not* set aside by *Fringilla frontalis* of Say = *Carpodacus frontalis*. If the two genera are merged into one *then blythi is* the correct name.

p. 129. *P. rodochrous* and *rodopeplus*. Surely these names must be spelt '*rh*' ? as all names should be which are derived from the Greek *rhodos*, a rose. Even if Vigors misspelt them originally a correction is provided for in Rule 19 of the International Rules—' errors of transcription, orthography, etc.'

p. 134. *Carpodacus*. If '*Carpodacus* is now often incorporated with *Propasser*' it is quite wrong to do so as *Carpodacus* is much the older genus. However perhaps exactly the opposite is intended.

p. 137. *Carpodacus erythrinus roseatus*. This name should date from Blyth (ex Tickell) *J.A.S.B.*, 1842, p. 461. Calcutta.

pp. 134–7. *Carpodacus erythrinus*. There is considerable difficulty in recognizing three races of this bird. We have in Northern Asia and Russia a bird in which in the male shows less red on the back and underparts and a female and immature with less streaks on flanks and abdomen than the Himalayan bird. These two races are perfectly recognizable and most individuals can be picked out. Over the huge intermediate area Asia Minor, Caucasus, Turkestan we find an intermediate bird which in many specimens exhibits more red than the northern birds but less than in the Himalayan ; these have been named *kubanensis*. It is a very poor race as so many cannot be placed ; thus I have examined spring birds from Kashmir, Ladak, Asia Minor, Tianshan, Tishkan, Kandahar, Gilgit, Pamir, N.W.F.P. and Samar-

khand which can easily be matched with birds from Himalaya; on the other hand others from Tianshan, Dharkend, Ladak, Gilgit and even Sikkim are intermediate and quite like Caucasus birds. In winter it is hopeless to try and differentiate this third race as the pink colour is so overlaid that it is not possible to say that any particular birds are less rosy than Himalayan ones or not.

p. 138. *Carpodacus rubicilla rubicilloides.* This bird is *not* a race of *rubicilla*—as Prof. Sushkin pointed out some time ago—but should stand as a species (with two recently described sub-species *lucifer* and *lapersonnei*) while *severtzovi is* a race *rubicilla*. The *rubicilloides* group are more heavily streaked on the upper parts and have a relatively longer 5th primary; the *rubicilla* group have the upper parts but faintly streaked and a relatively shorter 5th primary.

Mr. Whistler's notes (*B.N.H.S.J.*, xxx, pp. 186–7) certainly do not, so far as his own records go, apply to *rubicilloides*, as suggested, but quite correctly to *severtzovi* as stated by him and borne out by his specimens. The records he quotes could doubtless in many cases be verified or not by reference to specimens in the British Museum.

p. 140. *Erythrospiza.* This, as pointed out years ago by Salvadori in *Second Yarkhand Mission Aves*, p. 36 and others, and again more recently, is a synonym of *Carpodacus*; *Buchanetes* is the correct generic name.

p. 142. *Erythrospiza mongolica.* Baluchistan is included in the breeding range of this bird. It may breed there though I know of no proof; it occurs there in winter and up till April. Of its wintering in Sind I have no record, nor has Mr. Whistler for the Punjab; nor are there any specimens in the British Museum from anywhere in the plains of India.

p. 145. *Rhodopechys sanguinea.* Does this finch really occur in Baluchistan? I know of no instance of it. As there seems to be but one record of it—Khagan Valley—within our limits and that a 'sight record' perhaps Hazara was intended instead of Baluchistan. One 'sight record' seems extremely slender evidence for including any species in a work like the Fauna.

p. 150. *Carduelis c. major.* I cannot trace this doubtful record from Ziarat but Col. Meinertzhagen certainly obtained a specimen and saw another with it at Quetta on February 27. (Ibis., 1920, p. 138).

p. 152. *Carduelis caniceps subuluta.* I have elsewhere (*B.N.H.S.J.*, xxxi, p. 4) gone in to the question of races of the Himalayan Goldfinch; my conclusions were that *subulata* (= *orientalis*) seems distinct, large and pale, from *paropanisi*, darker and smaller, but the latter is not distinct from *subcaniceps* of Zarudny.

p. 155. *Acanthis cannabina fringillirostris.* Erroneous records are indeed hard to eliminate! This Linnet from 'Daotupper, Sind' is the one Murray said his collector got at Daulatpur in Sind and gave to Hume in whose collection it reached the British Museum. I have already shown (Ibis., 1922, p. 648) that the specimen in question came from Bushire in Persia.

p. 156. *Acanthis f. brevirostris.* This race was described from Erzeroum and it is exceedingly unlikely that it breeds in N. Ladak surrounded as it is by other races, viz. *rufostrigata*, *montanella* and *pamirensis*, nor does *brevirostris* apparently breed in Tianshan, it being confined to Armenia Caucasus and N. W. Persia. It would have been better to have omitted this race especially as the inclusion rests on reputed eggs apparently without parents—a very questionable mode of identification. Recently two other races have been described *ladacensis* from Ladak, and *baltistanicus* from Baltistan (on a single male!).

p. 166. *Gymnoris.* 'Like the true Sparrows it has an autumnal moult.' There is no point in this statement (repeated again on p. 185); that is, it would apply equally to almost *all* Passerine birds. The point is that like the true Sparrows the *juvenile* has a *complete* autumnal moult. It is only half true to say that the 'young are less downy than those of the true Finches' as the young of *Gymnoris* has *no down at all*, as obtains also in *Passer*.

p. 171. *Passer d. indicus.* I long ago pointed out that the House Sparrow of Mesopotamia and S.W. Persia, though recorded by older authors as *indicus* is really *biblicus* (*B.N.H.S.J.* 1921, p. 218).

p. 172. *Passer d. confucius.* If the House-Sparrow of Burma and S. India are the same, this name cannot be used. In 1838 Burton (*Cat. B. Mus. Fort Pitt Chatham*, p. 23) named Latham's Black-throated Finch *Pyrgita nigricollis*. Latham described a House Sparrow in fresh autumn plumage? or else faded? under this name and Burton's only specimens came from S. India. This race should be called therefore *Passer domesticus nigricollis*.

p. 174. *Passer pyrrhonotus*. There is a distinct difference in sex measurement here and the range of measurement given for wings is not wide enough. W. ♂. 67–71, ♀ 63·5–66 in a large series measured.

p. 175. *Passer hispaniolensis transcaspicus*. This bird apparently does not breed in British Baluchistan though it is said to do so in Persia north of Bampur.

p. 177. *Passer montanus montanus*. The inclusion of the typical race in the Indian Fauna rests on two specimens obtained by Whitehead in the N.W.F P. and are in the British Museum. They are decidedly paler than the typical race, month for month, and they are not so pale certainly as *fresh moulted dilutus* from Kashgar, but then one can hardly compare these with the two birds in question which were obtained in February and March. Baluchi birds seem quite the same as these birds of Whitehead's and I certainly should not at present separate them from *dilutus*.

p. 180. *Passer rutilans*. This is rather a difficult group and the arrangement here given does not seem quite satisfactory though I agree that four races are recognizable.

Passer rutilans cinnamomeus. Hartert created one difficulty in restricting 'the Himalayas' of Gould's type locality to Bhutan. Gould described the bird in 1835 at a date when no specimens of birds had been received from Bhutan and so his bird could never have come thence; moreover Gould says his bird (a male) had a wing of $2\frac{3}{4}$ inches = 70 mm. and however carelessly one may measure a Bhutan or East Himalayan male one cannot make it as small as 70 mm.; a bird of this size could only have come from the N. W. Himalayas. The measurements of males from Bhutan, Bhutan Duars, Sikkim, Native Sikkim, S. Tibet and Nepal are the same and are W. 75–81. (27 measured).

Passer rutilans debilis. From Kumaon to Kashmir the Cinnamon Sparrow is represented by a race which only constantly differs from the eastern bird in being smaller, an exception to the almost invariable rule that where there is difference in size the western birds are largest. The explanation is, I think, that the breeding quarters of the eastern bird are Southern Tibet and probably the higher parts of Sikkim and Bhutan and we know that Tibetan birds of many species tend to be larger than Himalayan. In British Sikkim it apparently does not breed (Macintosh; Stevens;). The paleness and more yellow on the underparts of the western bird is largely individual variation, birds quite as pale and as yellow being found in the east. Wings of males Kumaon to Kashmir 70–74 mm. (35 measured).

Passer rutilans intensior. This bird was described from W. Yunnan and 15 males thence measure 69–75 mm. The males and females are rather darker than Himalayan birds. Equally dark are the Burma birds (S. Shan, Chin and Karenni Hills. ♂ W. 71·5–72 (4 specimens). Manipur Hills, ♂ W. 68·5–71·5 (9 specimens); Shillong, ♂70–74·5 (7 specimens); Naga Hills, 70–73·5 (2 specimens); Miri Hills, 71·5 (1 specimen) all these are small and within the range of *intensior* and like the latter are darker in both sexes (more easily seen in females) than East Himalayan birds and therefore I should extend the range of *intensior* to the hills of Assam. Certainly one cannot, as Mr. Baker suggests, put the small dark Manipur birds with the much larger paler Tibetan ones.

p. 187. *Montifringilla n. alpicola*. It may of course be useful to include birds in the Indian list before they have been recorded but if this plan is adopted one can hardly see where one should draw the line. This bird seems to be included on the rather slender grounds that it was the form 'almost certainly seen by Whitehead in Chitral'—hardly satisfactory evidence for an authoritative work.

pp. 197–8. *Emberiza s. pallidior*. Wintering . . . to *North-east* India, surely North-west is meant? It extends in winter far beyond the N.W. Province Frontiers to the riverain of the Punjab and Sind.

p. 200. *Emberiza f. arcuata*. In this Bunting and in *E. pusilla* the tail feathers are narrower and more pointed at the tips than in most others, a character I do not recall having been noticed before.

p. 201. *Emberiza pusilla*. Here and in many other cases throughout the Fauna the adult plumage in summer, habits in summer, nidification are described at some length while little is said about the winter habits and plumage. It may be a matter of opinion, but it would seem to be more useful to give prominence to the *Indian* aspect of birds which are purely winter visitors.

p. 207. *Emberiza c. godlewskii.* It seems more reasonable to consider *cia* and *godlewskii* as two species and not races of one since both are represented by separate races in Tian Shan; nor is there any intergrading. The type locality of *godlewskii* is Kultuk in South Baikal. In view of the numerous races of *godlewskii* which have been described a re-examination of Indian material is desirable. The Tibetan bird has been described as *khamensis*, Sushkin.

p. 208. *Emberiza huttoni.* I must entirely disagree with the use of this name for this Bunting. Blyth described it as *Emberiza buchanani* from Buchanan Hamilton's drawings and the description is unmistakable (*J.A.S.B.*, xiii, p. 957, 1844). He says 'probably = *Emberiza hortulana apud Sykes*'. He described the bird again (xviii, p. 811, 1849) as *E. huttoni* apparently thinking he had made a mistake before, for in a footnote he says '*E. buchanani nobis* = *E. hortulana* L'. In Blyth's own copy of the *J.A.S.B.* Blyth wrote against this footnote 'No' showing that he realized later that he was correct in the first instance and that his *buchanani* was *not* the Ortolan of Linneus, as indeed it could not be by the description. Moreover no author can go back on his own names if the descriptions hold good.

p. 214. *Emberiza melanocephala.* This bird does not breed in British Baluchistan so far as is known; perhaps parts of Persia are included and meant here.

p. 215. *Emberiza icterica.* The distribution of this bird needs amending, the summer and winter ranges are not differentiated at all. Mesopotamia is included in the range whence there is but one record.

p. 219. *Emberiza calandra.* This bird has not only been *recorded* from Jhang in the Punjab but both Mr. Whistler and myself *obtained* it there; his specimen is in his collection and mine I presented to our Society's Museum. I mention this because our records seem to be put on a par with Murray's Sind bird which as I pointed out before (Ibis., 1922, p. 656) did not come from Sind at all but from Bushire in Persia, and one would think the 'record' need not have been resuscitated in a work like the Fauna.

pp. 219-220. *Emberiza citrinella erythrogenys.* Over a page is devoted to this species, yet its distribution in India has been entirely omitted! Has it ever occurred in India at all? I know of no record.

p. 226. *Delichon urbica urbica.* A good series of breeding birds from India are most desirable; all that I have seen are shorter winged birds than most of the typical race and I feel doubtful if the Indian birds belongs to the typical race. Surely it is not a common winter visitor to N. W. India!? Mr. Whistler obtained two specimens in 16 years in the Punjab and *only saw it occasionally on passage* to and from the hills.

p. 228. *Delichon u. cashmeriensis.* This is most certainly to my mind *not* a race of *urbica* but a separate species. Not only do both breed close together in Ladak but they do not intergrade anywhere. Moreover the tail is much more deeply forked in *urbica* and the proportions of tail to wing are quite different in the two; viz. :—1 to 2 in *cashmeriensis*, 1 to 1·6 in *urbica*; on such differences other species have been put into different genera!

p. 233. *Riparia riparia subsoccata.* When I described this bird as *R. r. indica* I went pretty thoroughly into any possible names already available. It is true that Jerdon's *subsoccata* refers to this Sand Martin but Jerdon who did not know the bird quotes what Adams said about it. The latter described the bird well and was the first to do so (*P. Z. S.*, 1859, p. 176) under the title *Cotile subsoccata* Hodgson? Unfortunately however Horsfield and Moore in their Catalogue (i, p. 96) in 1854 had already used up Hodgson's *nomen nudum* by quoting it as a synonym of *sinensis*, therefore *subsoccata* cannot be used for any other species.

p. 234. *Riparia r. ijimæ.* Under nidification this species is referred to by some curious slip as 'these little *Swifts*'!

p. 239. *Ptyonoprogne obsoleta obsoleta.* I too in the 'Birds of Sind' made the mistake of uniting the Indian and Egyptian bird and this I have (*B.N.H. S.J.*, xxxi, p. 4) since rectified. At the time I was working at them there was not sufficient material from Egypt available to me in the same state of plumage as the Sind birds. Since then however I have obtained a comparable series from Egypt, and Sind winter birds are distinctly *darker* than winter Egyptian ones; unfortunately however they must bear the name *pallida* of Hume.

p. 240. *Hirundo rustica rustica.* I cannot verify these wing measurements at all; surely no full winged adult has a wing so small as 110 mm.? I measure a fair series of adults, ♂ 124·5–132, ♀ 120–126. (W. Europe).

As regards the distribution of *rustica* and *gutturalis*, I shall confine my remarks to N. W. Indian birds. In the first place *gutturalis* is an eastern bird described from a winter bird in the Philippines and the breeding range of it is extensive over N. E. Asia. Now a series of adults from winter quarters—Philippines, Java, Sumatra, Malay (which may be taken as a topo-typical series and are the same as the N. E. Asiatic birds) present the following characters compared with W. European *rustica*.

1. Wing smaller, ♂♀ 109–120, mostly under 118 (25 measured).
2. Under parts variable; some whitish, some pinkish.
3. Red of throat and forehead deeper on the average.
4. Pectoral band variable; broken in some, in others smudged (i.e.) tips of some of the feathers in centre of band chestnut but band not broken. Now taking these characters separately; wing length is a good character there being but a small number which overlap; underparts—no guide at all; all over the range of *rustica* one may find birds with white or with pinkish underparts and every intermediate; deepness of chestnut red colour is an *average* distinction only; the pectoral band in *rustica* is never, I think, completely broken but 'smudged' bands are *often* seen so that this character is good only when the band is broken.

Now breeding birds from Cashmere, Gilgit, Yarkhand and winter birds from Sind, Punjab and Beluchistan are all large birds, wing ♂ ♀118, 119, 120–129 (25 measured); most have the band unbroken and some have it smudged but in none is it completely interrupted. I therefore consider all to be *rustica* and *gutturalis* not to occur in N. W. India at all.

p. 242. *Hirundo rustica tytleri.* The type locality was fixed by Jerdon as Dacca; if Oberholser also fixed it as Dacca it was a fortunate though needless act!

p. 245. *Hirundo smithi filifera.* This I think is a recognizable race though Mr. Baker hardly thinks so; the wing measurements may overlap but in measurement of the tail wires, I found only one overlap in 28.

Surely in this case the 'nestlings' and 'young birds' described are one and the same states of plumage? that is to say, the juvenile plumage in which it leaves the nest and which it retains till it moults to adult dress, as with other Swallows.

p. 248. *Hirundo daurica daurica.* This bird seems scarce in collections; in the British Museum and Tring Museum I find 21 specimens some of which are not sexed; the wing measurements are ♂ 127–133, ♀ 122–128–131. The statement that this race breeds in Shillong is not borne out by any specimens. I have seen four specimens taken within Indian limits:—♀ Sadiya, June 3; ♀ Sadiya, June 8 (type of Hume's *intermedia;* one Cachar, no date, in moult and so obviously not breeding; ♀ Cachar May (this bird seems to have a smaller bill than typical *daurica*); as we are told that it does not arrive in Shillong till late in July all the above birds in May and June may have been on passage for further north. That it should breed in Shillong would be very remarkable as the nearest breeding quarters are many hundreds of miles to the north, moreover in Shillong another race (*striolata*) certainly breeds. A few breeding specimens would be desirable.

p. 249. *Hirundo daurica striolata.* A series from the Southern Shan States, apparently breeding, are all large birds, W. 127–136, but there do occur small birds which seem to only differ in being small; thus a male from Cachar. W, 126 is 'type 2' of Hume's *substriolata* and another ♂ Manipur, W. 120, is exactly like it but may be this has been sexed wrongly. Here again there seems to be great lack of breeding and of sexed specimens. It would appear to breed in Central Formosa (specimens May and June) and perhaps Luzon and Lombok? (specimens July). The juvenile is distinctly heavier streaked below than the juvenile of *nepalensis*.

p. 250. *Hirundo daurica nepalensis.* This is perhaps the most difficult of a puzzling group and I have examined and measured every adult bird in the British and Tring Museums besides all in Mr. Whistler's collection, 102 specimens in all.

Adult. 1. Himalayas, east to Nepal; 25 specimens, ♂ wing 111–117, odd ones 119 and 120, ♀ 110–116.

2. Assam, Burma, Yunnan, 30 specimens, ♂♀ 116–125. Yunnan (Talit) May 21 and Mekong-Yangzte Divide June 5 are the only two which are possibly breeding birds.

3. China. 9 specimens, May to August, ♂♀ 112–124·5 from Shanghai, Chihli, Shantung, Kuangtung Provinces.

18 specimens, September to April, ♂♀ 114–124·5 from Shanghai, Chihli, Fokien, Kwangtung, Kwangsi Provinces.

Of these 27 specimens only 4 are under 115.

4. Japan. 7 Specimens, ♂♀ 117–124.

5. Corea and Manchuria, 9 specimens, ♂♀ 117–125. April and July.

6. Afghanistan, 3 specimens, 113–116. Pushut and Byan Khel.

It will be seen from this that topotypical *nepalensis* from the Himalayas are smaller birds than those from China, Japan, etc. and *on the whole* they are less coarsely streaked. The collar on the hind neck varies much ; in the types of *nepalensis* the collar is unbroken but I do not think this is constant for Himalayan birds ; in Chinese birds it always seems to be broken. In Assam, Burma and the plains of India one finds some birds are larger than the Himalayan breeding birds but since these are winter visitors they may not have come from the Himalayas. A series of breeding birds from Manchuria are quite strikingly different to a similar series from the Himalayas and though every bird from China and Japan are not to be picked out from Himalayan birds I think that as a race they should be recognized and the name for them will be *Hirundo daurica japonica* of Tem. and Schl. As all Chinese and Japanese birds seem quite the same ; *Hirundo arctivitta*, Swinhoe described from Pekin (4 examined, only one adult) is not different to *japonica*.

The three birds from Afghanistan are *not nepalensis*, they have hardly any striæ on the underparts and seem quite like *rufula* but are smaller than this race. Further material is desirable ; if it should turn out to be a recognizable race the name *H. scullii* cannot be used for it. It was said in the description of this that it occurred in Gilgit and Nepal but the type in Seebohm's collections was obtained by Scully in ' the Residency grounds in Nepal ' (*vide* B. M. Cat.) and therefore *scullii* must be a pure synonym of *nepalensis*. In the Ibis, 1916, p. 71 I identified some birds of Mr. Whistler's from Jhelum as *scullii*, but *nepalensis* is of course the older name.

p. 252. *Hirundo daurica rufula*. I think I am correct in saying that Mr. Whistler certainly never found this race breeding in the Kangra Valley, and certainly no specimens in his collection refer to this race. The mistake arose (*B.N.H.S.J.*, xxi, p. 659) through this bird being identified as *scullii* and Mr Whistler's remarks that this ' apparently corresponds to *Fauna of B.I.* No. 824, *H. rufula*.' The bird in question is *nepalensis*.

p. 251. *Hirundo daurica erythopygia*. There is much yet to be learnt about the distribution of this race in the Himalayas. In some places it ascends to over 4,000 ft. and breeds in same area as *nepalensis ;* it requires very detailed study. The distribution in the plains of India is hardly as wide as is given, as it is practically absent over a very large part of the Punjab and Sind. In the description this race is compared with *striolata* and *daurica* but size alone will differentiate it from these two as the measurements do not overlap ; moreover it does not occur in the same area. It is from *nepalensis* that it needs to be distinguished ; chestnut colour is darker and on the rump does not pale off so much as in *nepalensis*, the exposed black of the undertail coverts is not so extensive—10 to 16 mm. as against 15–25 in *nepalensis ;* and besides having a shorter tail, as pointed out, the fork of the tail is consequently not so deep—from the tip of the centrals to the tip of the laterals in *erythropygia* is 30–37 mm, whereas in *nepalensis* it is 40–50 mm. Wing length is not so diagnostic, *erythropygia* mostly 105–113, *nepalensis* 111–117 ; I cannot find any adult *erythropygia* with a tail as short as 65, I measure ♂ 76–83 ♀ 72–78, in a long series. In the juvenile the rump is distinctly darker than in *nepalensis*, in fact in the latter when worn it is not darker than cream-coloured.

p. 256. *Motacilla alba*. The difference in wing length between *alba* and *dukhunensis* has not been stressed *alba*, ♂ 88–92·5, ♀ 84–88·5, *dukhunensis*, ♂ 91–96, ♀ 84–91. These measurements, taken from W. Europe and from Yenesay specimens, may be useful to distinguish doubtful specimens.

p. 258. *Motacilla a. persica*. Unless an adult male of this race has been found in India, it is best omitted from the Indian list as it is most unlikely to occur ; so far as we know it is quite resident in its range and that it should

migrate hundreds of miles eastward would be quite a new fact which only ought to be recorded on incontravertible evidence. *Persica* is rather paler on the back than *personata* and slightly smaller, and has a longer bill than *dukhunensis*.

p. 261. *Motacilla lugubris*. Surely the correct name is *M. yarrelli* as pointed out by Newton and others years ago? ; *lugubris* of Temminck was quite indeterminable. In any case if one follows Mr. Baker in considering *maderaspatensis* a race of this group, and not a species in itself as I do, then the latter name must be used for the group as it is many years older.

Any one who wishes to identify any but the adult males of *alboides* and *personata* will find some help in *J. B. N. H. S.*, xxviii, p. 1089 where I went rather fully into the question, and also into the reason for considering *maderaspatensis*, a species of itself.

p. 265. *Motacilla cinerea* The tail length is given as 75 mm. ; it should be 95. This mistake is repeated on page 266 where the tail length 67-73 should be 87-93.

The down of *M. c. caspica* is dirty white.

p. 267. *Motacilla flava*. Further details of the plumages of *beema* and *thunbergi* will be found (op. cit., p. 1087) and also the distinguishing characters of the male of *Motacilla flava simillima* which has been omitted altogether in the Fauna. The only Indian example of *leucocephala* was obtained by Mr. Whistler at Jhelum ; for first occurrences it is surely of interest to give full data.

p. 271. *Motacilla feldegg*. More details on the plumages of both races will be found in op cit., p. 1086. Mr. Baker says the young (= 1st winter) of *feldegg* have no trace of a supercilium if that is so they should be quite easily distinguished from first winter *melanogriseus* which has a well-marked whitish or buffish-white supercilium as I pointed out (*loc. cit*).

Some few adults which occur in India may not be separable from *feldegg*, the vast majority I think are undoubtedly *melanogriseus*. The Shiraz breeding bird is quite certainly *M. f. feldegg* (series of breeding birds examined) and not *melanogriseus* as Mr. Baker states nor did Mr. Witherby ever record them as *melanogriseus*.

p. 273. *Motacilla citreola*. I went very carefully into the question of the plumages of both sexes and of all ages in *citreola* and *calcarata* (op. cit., p. 1084) and to this I must refer all who wish to distinguish them as only a very small percentage could be differentiated by the descriptions given in the Fauna. I also pointed out that *calcarata* has the longer tarsus whereas Mr. Baker gives *citreola* the longer. I do not think he is right. The combined measurement of tarsus, middle toe and claw in *citreola* is usually well under 47 mm. and in *calcarata* well over 47 mm.

Although not alluded to, it was pointed out by Prof. Shushkin (*Proc. Boston. Soc.*, August 1925) that *M. c. weræ* from S. E. Russia and Turkestan is a recognizable race in that it is smaller (♂ W 77–85) and is less grey on the flanks and this is the form found in N. W. India in winter whereas the Bengal, Assam, and Burma birds belong to the typical race *citreola* from E. Siberia (♂ W 88–93) see also *Bull. B. O. C.* xlvi, p. 114.

p. 276. *Dendronanthus indicus*. Distribution. In winter south to India *east*, not west, of a line from Sutlej Valley to Gulf of Cambay.

p. 278. Genus *Anthus*. To say that 'the difference in plumage in summer and winter is negligible' is rather an astounding statement; one could hardly find more different looking birds than say winter and summer *blakistoni* or *japonicus* or again winter and summer *cervinus*.

p. 279. *Anthus trivialis trivialis*. The type locality should be *Sweden*, not Switzerland.

p. 281. *Anthus hodgsoni hodgsoni*. The winter distribution given is far too sweeping. There are enormous stretches of N. W. India where it is not found in winter as I pointed out in *Ibis*. 1923, p. 7.

This species is highly variable and one may see birds obtained at the same place and same time of year which look utterly different ; some have the upper parts heavily spotted others have hardly a spot ; such birds I have seen from Sikkim in August and from the plains in winter. *Berezowskii* does not seem to be a recognizable race at all ; Kansu birds in worn dress of course have lost the green of the upper parts but so have Himalayan ones. Spring birds from Kansu and China, etc., are not different to Himalayan ones ; they do not appear to me to be darker. *Yunnanensis* is only recognizable in a series in fresh autumn plumage when on the whole the upper parts are darker ; in breeding

dress a series from Yunnan do not seem to be separable from a similar series from the Himalayas; a poor race.

p. 287. *Anthus sordidus decaptus*. Sind is apparently included in the breeding range of this bird; it is only known as a winter visitor there. Besides size, this race differs from *A. s. captus* in being less pale and grey above in fresh plumage.

p. 289. *Anthus richardi godlewskii*. It is quite true that *striolatus* of Blyth cannot be used for this bird as in some unaccountable way (? from Blyth's MS.) Gray quoted Blyth's name as a synonym of *rufescens* in the year before Blyth ever published his name. But by the same interpretation of the rules of nomenclature *Anthus thermophilus* of Jerdon must be used for this bird as in the *Birds of India*, p. 233. 1863, Jerdon uses Hodgson's *nomen nudum* as a synonym of *striolatus* with description. This bird must then be called *Anthus richardi thermophilus*, Jerdon, ex Hodgson. Type locality Nepal. The distribution given is too sweeping; this bird does not occur over the greater part of N. W. India at all.

p. 291. *Anthus richardi rufulus*. I feel very doubtful if *rufulus* is a race of *richardi*; it appears to me to be more probable that it is a species which itself has many races both in the Oriental and Ethiopian regions. The form of this bird which occurs in Ceylon is certainly *not* the same as inhabits Bengal and N. India generally; it is a much darker bird and I cannot separate it from *malayensis* and so should extend the range of that race to Ceylon.

p. 292. *Anthus campestris campestris*. The Tawny Pipit, is a common bird in N. W. India in winter and Mr. Whistler and I have a very large series from Sind and the Punjab. Not a single specimen belongs to the typical race, yet from the distribution given one may infer that it is common. I cannot credit it and from the breeding distribution of the race one would hardly expect it to be.

The wing measurements given are misleading and must apply largely to females, as I measure a series of males as 91–98·5 mm.

p. 293. *Anthus campestris griseus*. This was described in 1920, not 1923. Here again the measurements given can only apply to females; a large series of males measure W 89–95, T 71–76. The habits of this bird in India have been recorded by me (Ibis., 1923, p. 7).

p. 294. *Anthus cervinus*. The red head and throat is certainly acquired before the third year. I have examined specimens moulting into the red dress in the first spring and this is probably normal, whether they then get redder and more immaculate with age is speculation.

p. 296. *Anthus roseatus*. Habits. It is unfortunate that in so many cases so little space is devoted to habits. In this species the habits in the breeding season only are briefly referred to. The habits in winter have been recorded over and over again by Indian writers and are so utterly different to the breeding habits that some mention might have been made of them. But we are told only that the habits are ' those of the genus.' It is not at all clear what is meant by this statement which is repeated again under Tawny Pipit and one of the Water Pipits. No description of the habits of the genus is given under the genus *Anthus* and as several of the species have entirely different habits to refer to any one species has having the ' habits of the genus ' seems meaningless.

pp. 297–8. *Anthus spinoletta*. The two races *coutelli* and *blakistoni* are not very satisfactory at least as regards winter birds; so many are intermediate between what may be called typical specimens of the two races and as stated we know so little about the breeding ranges of both races. Probably both have a very large range and intergradation is found. *Coutelli* certainly breeds on the Persian plateau.

The winter habits of *coutelli* have surely been recorded ? it is one of the commonest birds in the Nile delta. I have measured a large series of topotypes of these two races and could find no difference at all in measurements (cf. *B.N.H.S.J.*, xxviii, p. 229). It would have been more helpful I think to have given the winter plumage of *coutelli* as summer plumaged birds in India must be very rarely met with, moreover the description of *blakistoni* is compared with *winter coutelli*.

p. 309. *Otocoris alpestris longirostris*. Spiti, Lahul, and Kulu should be added to the distribution of the race. *Elwesi* reaches as far west as the Tso Kar, Tso Moriri and Pangong Lakes in Ladak and north to Aktagh north of the Karakoram Pass that is to say to long. 78°E. The rest of Ladak, except

the Deosai plain whence a recently described race comes, is inhabited so far as is known by *longirostris*. Baluchistan however would seem to be outside the range of this latter bird ; I know of no record within the boundaries.

p. 313. *Melanocorypha bimaculata*. This bird does not so far as is known breed in British Baluchistan.

p. 315. *Alauda arvensis dulcivox*. This bird does *not* breed in Baluchistan. The Skylark breeding at Quetta recorded by Marshall and others is a *gulgula*. Whitehead never recorded an *arvensis* breeding on the Afghan Frontier ; he expressly states that *arvensis* was a winter visitor there and the breeding bird is a *gulgula*, as might be expected. As he well knew the difference between the two birds he probably was not mistaken. The Persian breeding bird is *Alauda arvensis schach* which seems to be perfectly recognizable and nothing like *dulcivox*.

p. 319. *Alauda gulgula gulgula*. Wing measurements of races of Skylarks which do not give measurements for each sex are of little value as there is a considerable difference between male and female. In this case the measurements given 82–92 can surely only apply to females ? as a series of males measure 92–97 mm.

p. 321. *Alauda g. cælivox*. *For* ' Distribution ' *read* ' Description.'

p. 324. *Calendrella brachydactyla brachydactyla*. The Short-toed Larks are admittedly difficult birds to place as they vary a good deal but it appears to me that the typical race has been dragged into the Indian list on somewhat, slender grounds though the erroneous breeding distribution given makes its inclusion look quite possible. The bird which breeds in Palestine is *hermoniensis* as also are the few Persian birds I have seen. No form of *brachydactyla* breeds in British Baluchistan so far as we know. Where then do the supposed examples of the typical race found in winter in India come from ? I can hardly credit that they migrate from South Europe. I think the truth is that we have in this group a species which varies slightly in colour according to the ground it inhabits in the breeding season and that though the prevailing tone of colour of the central Asiatic birds (*longipennis*) is paler and greyer, yet over this area there will be found some which are browner and redder and resemble the European bird and these are the ones which pass as the typical race in India. If we are to maintain these three races at all I think this is the most reasonable explanation and not to imply that European birds migrate to India in winter. These browner Asiatic birds were apparently given a name *C b. orientalis* in 1925 by Sushkin.

p. 326. *Calandrella b. dukhunensis*. This race largely replaces *longipennis* in Central and Eastern India. The more rufous upper parts and the tawny tinge on the pectoral band and flanks coupled with a slightly longer wing and bill differentiate the vast majority. In the British Museum there is a fair series of these but some so labelled do not, I consider, belong to this race. The wing measurement ranges from 95 in small females to 104 in males ; I find none so small as 90 mm. as stated. There are no specimens *west* of Etawah and Mhow nor are there any specimens from Karachi. Sind and the Punjab lie outside the range of this bird.

p. 327. *Calandrella acutirostris acutirostris*. The breeding range must certainly be extended to British Baluchistan and probably to Afghanistan. I cannot separate a sufficient number of *tibetanus* to justify its recognition ; the amount of white in the tail varies very much and so does the colour of the upper parts.

p. 329. *Alaudula*. It is of course a matter of opinion whether such characters as shortness of inner secondaries and slenderness of bill constitute grounds for generic separation. However in this case slenderness of bill surely does not hold good as *persica* has a stouter bill than some *Calandrella*.

p. 331. *Alaudula raytal adamsi*. The wing measurements of this bird reach as correctly stated 88 mm., but as this is so it upsets the key to the species on page 329 where birds with wings over 85 are referred to *rufescens*.

p. 332. *Alaudula rufescens persica*. The wing measurements given are too small, none out of a large series I have measured is so small as 86 ; 94 I found to be the minimum. It is not clear what the locality of the supposed eggs taken by Barnes is. Peshawar is not in Afghanistan ; perhaps in Afghanistan near Peshawar is meant or possibly Peshawaren on the Helmund ? but if Barnes did not get the breeding birds surely no value can be attached to this record ? It is however not correct to say there is nothing on record about the breeding of *persica* as it has been fairly well described by Blanford (*Eastern Persia*, ii, p. 243)

under the name of *Calandrella pispoletta*; Blanford's breeding birds obtained and so recorded were *persica* (examined by me). This race has occurred at Sirsa in Punjab in winter but not I think in Sind—at least I have been unable to find any examples thence in the British Museum.

p. 333. *Alaudula rufescens seebohmi*. In addition this race has occurred at Sirsa in Punjab (Hume coll.) and in N. Baluchistan (Meinertzhagen).

p. 333. *Mirafra*. The wing has surely 10 primaries; by a slip it is said to have two!

p. 344. *Galerida cristata chendoola*. I should certainly expect the breeding birds at 7,000 feet in the N.W.F.P. to be *magna* and not *chendoola* as also obtains in N. Baluchistan and I have no recollection of ever saying nor I can find that I have ever recorded the exact opposite, as Mr. Baker avers. Mr. Baker is not correct in saying that this species never perches on bushes or elevated positions. I have seen it sitting on the top of tall euphorbias and on telegraph wires on innumerable occasions as I recorded, Ibis. 1923, p. 18 and *B.N.H.S.J.*, xxviii, p. 226, for *magna*.

p. 349. *Ammomanes*. There is a muddle over the proportions of the primaries in the introduction to the genus. Obviously the first primary cannot be one-third the length of the second and the latter 6 mm. *shorter than the first!*

p. 350. *Ammomanes phœnicura phœnicura*. Distribution given should be *east* of a line drawn from Rann of Cutch to Delhi, *not west* of it.

p. 351. *Ammomanes phœnicura zarudnyi*. This bird has also occurred in Sind, a fact I was not aware of when I wrote the *Birds of Sind*. I have however since found a bird in Tring Museum obtained by Blanford on December 21, 1875, near Sehwan; he had passed it over as an immature of *phœnicuroides*. Status in Sind not known; elevational migrant from Kelat? or possibly resident?

pp. 353–4. *Pyrrhulauda grisea*. The bird inhabiting the dry plains of N. W. India is easily separable from the South Indian bird. I described it as *P. g. siccata* (*Bull. B. O. C.* ccxcv, March 1925). Mr. Baker has omitted all reference to this though the Bulletins of May and October 1925 are quoted for other species.

p. 358. *Zosterops*. The grouping of this difficult genus did not seem very satisfactory nor in accord with my experience and I have recently gone into this group and some of the results are given in the *Bull. B. O. C.* xlvii, February 1927. For those who have not seen this I will repeat the main points and add a few others.

Zosterops palpebrosa. There is no doubt that Temminck described the Bengal bird, and probably from near Calcutta, and this is the darker, greener type as opposed to the paler, more yellowish bird found over N. W. India, etc. This latter Mr. Baker has recognized but unfortunately he described the yellower bird (*elwesi*) as being smaller and placed the type locality of it as Sikkim. However there is not the slightest doubt that the Sikkim and Bengal birds are the same and therefore *elwesi* is synonym of *palpebrosa*, they are of the same colour and have the same measurements:—

Bengal, W. 49–55, B 11·5–13.
Sikkim, W. 49–54, B 11·5–13.

So that the yellower bird which also is *larger*, not smaller, still lacked a name and for it I proposed the name *Zosterops palpebrosa occidentis* (*Bull. B. O. C.* xlvii, p. 88). This bird ranges through the Himalayas from the vale of Nepal westward to Kashmir, N.W.F.P., Punjab, Sind (Karachi), W. United Province, Central Province, east to Raipur, Rajputana and Bombay Presidency south to N. Kanara and Mysore. W. 53–59, B 11·5–13.

Mr. Baker has separated the Assam bird as *cacharensis* and says it is smaller than the typical race and shews a yellow streak down the abdomen. I have examined Mr. Baker's type and a series of topotypes and in all 62 specimens from Assam and I find the abdominal streak or a trace of it in only 22 specimens. This seems hardly constant enough to constitute a recognizable race and moreover it is found in specimens outside Assam, thus quite a number from Sikkim show it also some from Yunnan and from the Nilgiris. The wings of Assam birds measure 49–54·5, quite the same as in *palpebrosa*, and therefore I consider *cacharensis* to be also a synonym *palpebrosa*. The range of the typical form will then be Bengal and Sikkim east to Assam, Kauri, Kachin, N. and N. W. Yunnan, S. Shan States and Karenni. The distribution

south of Bengal still needs working out and there are no specimens for examination from N. Circars and Orissa, Hyderabad State and Madras.

The bird which inhabits the Nilgiri and Palni hills is I consider separable; it is of the same coloration as *palpebrosa* but it is larger in wing and bill I have named this (*loc cit.*) *Zosterops palpebrosa nilgiriensis*, W. 54·5–58, Bill, 13-14; doubtfully separable from this is the Andaman bird but the Nicobar bird *nicobariensis* has also a large stout bill but is smaller in wing, 50–53·5. The Ceylon and Laccadive bird *egregia* is peculiar in being even brighter and yellower above than *occidentis*, as most Ceylon races run to darkness in colour.

In coming to these conclusions I have examined and measured over 300 specimens.

Zosterops simplex. This is the Chinese bird and Mr. Baker recognizes a race of it within our limits—*peguensis*. The series available in the British Museum do not seem to be different to birds from China either in colour or size. There is no doubt that although *simplex* is rather like *palpebrosa* it must at present be considered a species and not a race. Both *appear* to breed over a considerable area in W. Yunnan. The same remarks apply to *aureiventer* which within our limits appears to overlap the ranges of *palpebrosa* and *simplex* in Burma. But there is yet a lot of careful field work and collecting to be done in the areas where two species occur to ascertain their distribution, whether there is any altitudinal difference in habit and whether there is any interbreeding and intergrading.

p. 378. *Æthopyga siparaja seheriæ*. The geographical range of *seheriæ* and *mussooriensis* seems to be entirely a question of east and west, all males from Sikkim and Native Sikkim have short wings (54 5-58 mm) as have also males from Bhutan, Assam, etc., whereas the western birds are larger (61–62·5 mm.). The difference is small but the variation in wing length of all Sun birds seems to be very little. Nepal birds (*miles*) stand out rather prominently with dull grey underparts with no olive green or only a trace (wing 55-61) and I think this race should be maintained. It seems hardly credible that Hodgson's method of preparing his skins should account, as suggested, for the grey underparts. *Andersoni* with violet crown and tail, instead of green, is, I think, no doubt, a sporadic variety (4 examined from N. Bhamo, Minjin and L. Chindwin). Quite typical *seheriæ* also occurs in Bhamo and Upper Burma (which is omitted in the distribution of *seheriæ*). Violet and green metallic reflections vary in many sunbirds, sometimes geographically and sometimes not, but the wetting of the plumage as suggested by Mr. Baker as the cause in this case has, I am sure, nothing to do with it as I have experimentally proved. The crown of *seheriæ* when wet goes dull but on drying out the original green reflections are restored.

The juvenile of this and of *mussooriensis* is *not* like the female; juvenile male has the throat and chin brick pink, the juvenile female has not but is greyer, not so yellow on the underparts; *otherwise* they are much as in the adult female. Full plumage is assumed by complete moult and this is then held all the year as also in *vigorsi*, the moult taking place in this species (or race?) from March to May in both sexes.

I think Mr. Baker is quite right in rejecting the name *goalpariensis*; the type specimen is certainly labelled as from Dehra Dun, but it is a quite typical *seheriæ* with wing 55 and certainly never came from this locality, as all other specimens thence are quite typical *mussooriensis*. But surely this last race does not reach the Afghan frontier? Dharmsala is the furthest west I can trace it.

p. 383. *Æthopyga ignicauda ignicauda*. Males, wing 58–61. There is not the slightest doubt that this species like *Cinnyris asiatica brevirostris* has a dull winter dress. It is green like the female but the underparts are brighter yellow and often show some odd orange feathers. Tail longer than in the female, outer webs red, centrals not prolonged more than half an inch beyond the rest, otherwise tail as in summer; tail coverts scarlet, rump yellow. Many specimens in this dress in the British Museum are labelled females but by measurements alone they are sexed wrongly. Moult out of this dress starts in February and lasts till April the body plumage, central tail or whole tail, but apparently not the wings, are moulted to the full dress. After breeding the males moult again and assume the above dull dress (specimens in old full dress with the new green feathers 'in pin' examined).

p. 384. *Æthopyga flavescens*. A specimen from the Naga Hills seems to be of this race.

p. 386. *Æthopyga gouldiæ gouldiæ*. Juvenile. Like the female but tail not so graduated, nor tips so white. Complete moult September to December to full dress which is then retained all the year.

p. 387. *Æthopyga dabryi* or as I should call it *Æthopyga gouldiæ dabryi*. Juvenile. Only one seen (unsexed) is like female but tail not so graduated and tips not so whitish ; complete moult January to April (or earlier ?) to full dress which is retained the whole year.

p. 388. *Æthopyga saturata*. Juvenile (unsexed) is like female but tail not so graduated and tips not so white. Complete moult to full dress which is then retained all the year. Surely *sanguinipecta* is a race of this ?

p. 391. *Æthopyga nipalensis*. Juvenile (unsexed) is like the female but tail not so graduated and tips not so white ; one, perhaps a male, has an orange wash on the breast which another labelled female lacks. Complete moult to full dress which is then retained all the year.

p. 393. *Leptocoma*. The Sunbirds can be split into almost as many genera as there are species according to the varied ideas of generic distinctions. The type of the genus *Cinnyris* is *C. spendida* (by subsequent designation of Gray) and this bird does not seem to be sufficiently generically distinct from such Sunbirds as *lotenia*, *asiatica* and *osea*. Now *osea* and *asiatica* are so close that the one might almost be considered nothing but a race of the other yet we have an Indian faunist putting *asiatica* in a genus *Leptocoma* and an Ethiopian faunist putting *osea* in the genus *Cinnyris !*

p. 394. *Leptocoma lotenia*. Unlike *asiatica brevirostris*, adults seem to have the metallic dress all the year, moulting September to November. The juvenile has a complete moult in April and May to the adult dress. Is Mr. Wait correct in suggesting that the adult has a distinct winter dress ? (*Birds of Ceylon*, p. 164). I have certainly examined two birds September and November moulting from metallic to metallic dress.

p. 401. *Leptocoma ornata*. There is something wrong with the reference to Lesson. The date I think should be 1826.

p. 421. *Dicæum*. A neuter genus always accentuates the difficulty as to how the specific name should terminate. The International Rules help up to a point as Rule 14 states that the specific name should agree, if an adjective, with generic and Rule 19 states that the author's spelling should be adhered to unless there is an error of orthography, transcription, etc. But the difficulty is to know whether an author intended his name to be an adjective or a substantive and whether therefore there has been an error in orthography or not ; and the difficulty always arises in cases of compounded words. It should be clear I think that where two substantives have been compounded into a specific name this should be kept as a substantive unless the original author clearly has treated it as an adjective ; thus *ignipectus* should not be altered to *ignipectum* (p. 427). So also Eyton clearly intended *ignicapilla* to be a substantive and this should not be changed to *ignicapillus* (p. 437). Words compounded of an adjective and substantive are not so clear and I think one should follow the original author's spelling ; for instance Hume wrote *Zosterops aureiventer ;* did Hume make a grammatical error or did he intend his word to be a substantive ? He must have been perfectly well aware that *zosterops* is a feminine noun. Words derived from the Greek and ending in *os* are another difficulty. Latham and Linnæus spelt their specific names, if proper names and therefore substantives, with a capital but they clearly also intended words ending in *os* to be substantives also ; thus Latham in his genus *Certhia* makes all adjectival specific names agree in the feminine but he writes *Certhia erythorhynchos* and this should not be changed to *erythrorhynchum* when associated with *Dicæum* (p. 432) though such adjectives as *ceylonensis* (p. 433) and *siamensis* (p. 424) ought certainly to be altered to *ceylonense* and *siamense*. These are trivial points of no real importance but one still hopes for the uniformity in these matters which appears as unattainable as ever.

Corrigendum to vol. ii. *Phylloscopus t. sindianus*. I have since seen good series of breeding birds from Ladak and I think that there is no doubt that this race breeds there. I am not sure that still yet another race does not occur in the plains in winter ; three other races have been described by Russian ornithologists which if recognizable might occur in winter in India.

TWO NEW SPECIES OF GRASSES FROM PANCHGANI

(Satara District)

(*With two plates*)

BY

E. Blatter and C. McCann

Dichanthium panchganiense, Blatter and McCann, *spec. nov.* (*Andropogoneæ—Amphilophiastræ*). A *Dicanthio armato* Blatter and McCann (=*Andropogon armatus*, Hook f.) differt praesentia ligulae laceratae, gluma involucri inferiore spiculae sessilis, gluma involucri superiore spiculae pedicellatae semper foveolata.

Foveola supra indicata hanc speciem a *Dichanthio McCanni* infra descripto distinguit.

Annual, erect; stems up to 35 cm. long, slender, tufted or not, simple or branched from near the roots, smooth and shining; nodes bearded. Leaves up to 8 cm. by 4 mm., linear, acuminate, broadest in the middle, short-ciliate, on the margins, with long, bulbous-based hairs on the surfaces, which are much longer at base of the blade for about 5 mm.; sheath lax, margins and upper two-thirds covered with bulbous-based hairs, mouth with much longer bulbous-based hairs; ligule narrow, membranous, lacerate. Racemes digitate, 1-3, about 3 cm. long. One or two of lowest pairs of spikelets male. Peduncles up to 8 mm. long, capillary; joints and pedicels slender, not grooved, terete, hairy. Spikelets about 18 pairs. Sessile spikelets 3 mm. long; callus very short, bearded with silky hairs; lower involucral glume thin, broadly oblong, substruncate at apex, margins incurved, 7-nerved, always with a deep dorsal pit about $\frac{1}{3}$ from the apex, hirsute throughout except on the pit and the area between the pit and apex, upper involucral glume, oblong-lanceolate, longer than the lower, subacute at apex, keeled, glabrous except on the hairy keel. Lower floral glume oblong, flat, hyaline, nerveless, acute or obtuse at apex, a few scattered hairs on the margins; upper represented by a slender awn about 20 mm. long and twisted in the lower part. Pedicelled spikelets 4 mm. long, broader than the sessile. Lower involucral glume slightly convex, many-nerved, armed with spreading marginal bulbous-based bristles up to twice as long as the glumes, hairy between the bristles and on the dorsal surface, with a smooth shallow pit; upper slightly longer than the lower, broadly oblong, acute, 3 nerved, ciliate on the margins. Lower, floral glume oblong, obtuse, hyaline, nerveless, sparingly hairy; upper almost thread-like. Anthers yellow, filament forked, one branch bearing one anther, the other branch again forked.—Plate 1.

The pits observed in the sessile spikelets contain a viscid substance. It is not impossible that the latter plays a part in pollination.

Habitat: Found by C. McCann in the village and on the Tableland of Panchgani, Satara District of the Bombay Presidency, November 1925.

Dichanthium McCannii, Blatter, *spec. nov.* (*Andropogonæe Amphilophiastrae*).

Dichanthio armato, Blatter and McCann (=*Andropogon armatus*, Hook f.) recedit praesentia ligulae, numero racemorum, magnitudine spicularum, nervis glumæ involucri inferioris spiculae sessilis, gluma involucri inferiore spiculae pedicellatae alis praedita, aliis ex descriptione patentibus.

An erect tufted grass; stems up to 45 cm. long, slender, simple or branched from about the middle, glabrous, shining, nodes densely long-bearded; internodes up to 7 cm. long. Leaves up to 10 cm. by 6 mm., linear-lanceolate, broadest at the base, amplexicaul, covered all over with bulbous-based hairs which are much longer at the base for about 15 mm; sheaths lax, covering the internodes for $\frac{1}{2}$ and more, glabrous except on the outer margin and the upper third of the whole sheath which are covered with bulbous-based hairs; ligule narrow, 1 mm. broad, made up of bristles united at the base. Racemes solitary or 2, up to 37 mm. long; the 3 or 4 lowest pairs of

spikelets all male and alike in shape; peduncles of binate racemes about 1 cm. long, capillary; joints and pedicels slender, of the lower 3 or 4 pairs of spikelets glabrous, of the rest a line of ciliate hairs all along on one side of joint and pedicel and with a few cilia on the opposite side. Spikelets up to 17 pairs. Sessile spikelets 4 mm. long; callus very short, bearded; lower involucral glume pale, 7-nerved, the central nerve running only half way up, 4 mm. long, not keeled, stiff-haired in the upper ⅔ (no dorsal pit), margins much incurved, tip subobtuse, purplish; upper involucral glume slightly longer than the lower, broadly lanceolate, acute, margin incurved, keeled on the back, otherwise nerveless, hairy towards the tip along the margin and on keel. Lower floral glume narrowly oblong, rounded at apex, flat, hyaline, nerveless; upper represented by a slender awn, 28 mm. long, twisted in the middle third. Pedicellate spikelet 1 mm. longer than the sessile and broader. Lower involucral glume 5 mm. long, narrowly ellipsoid, acute at apex, slightly convex, strongly 10-nerved, very narrowly winged in the upper third, wings purplish, spinous-serrate with stiff hairs, armed with spreading submarginal bulbous-based bristles which are often as long as the glume, otherwise glabrous; upper involucral glume broadly lanceolate, slightly longer than the lower, 3-nerved, apex acute, margins broadly incurved, outer side glabrous, inner side silky hairy. Lower floral glume oblong, obtuse at apex, as long as the upper involucral glume, hyaline, margins silky-hairy in the upper half, upper narrowly oblong-lanceolate, hyaline, slightly shorter than the lower, apex acute.—Plate 2.

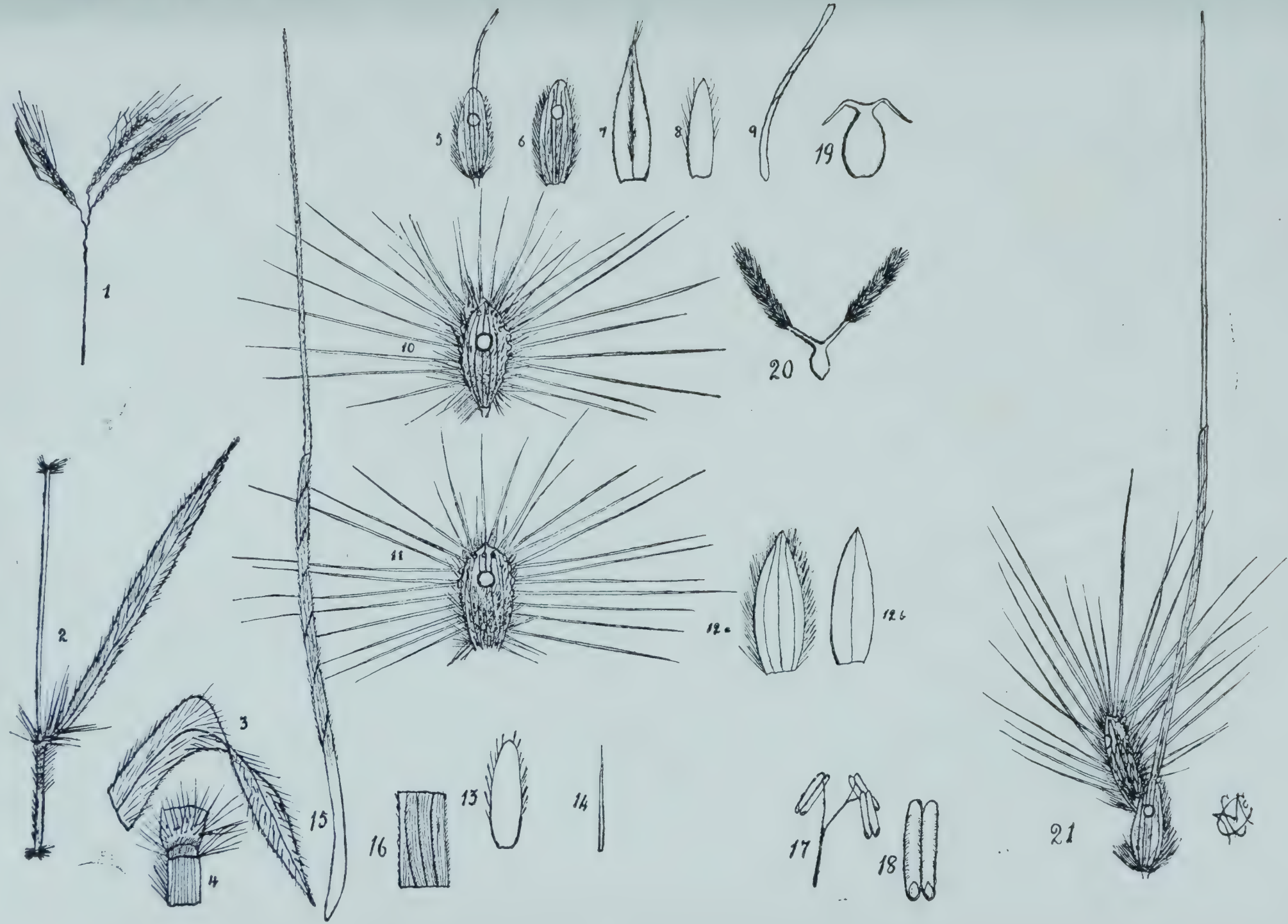
Habitat: Found by C McCann east or the third Tableland of Panchgani, Satara District of the Bombay Presidency, October 1925.

Text for Plate 1

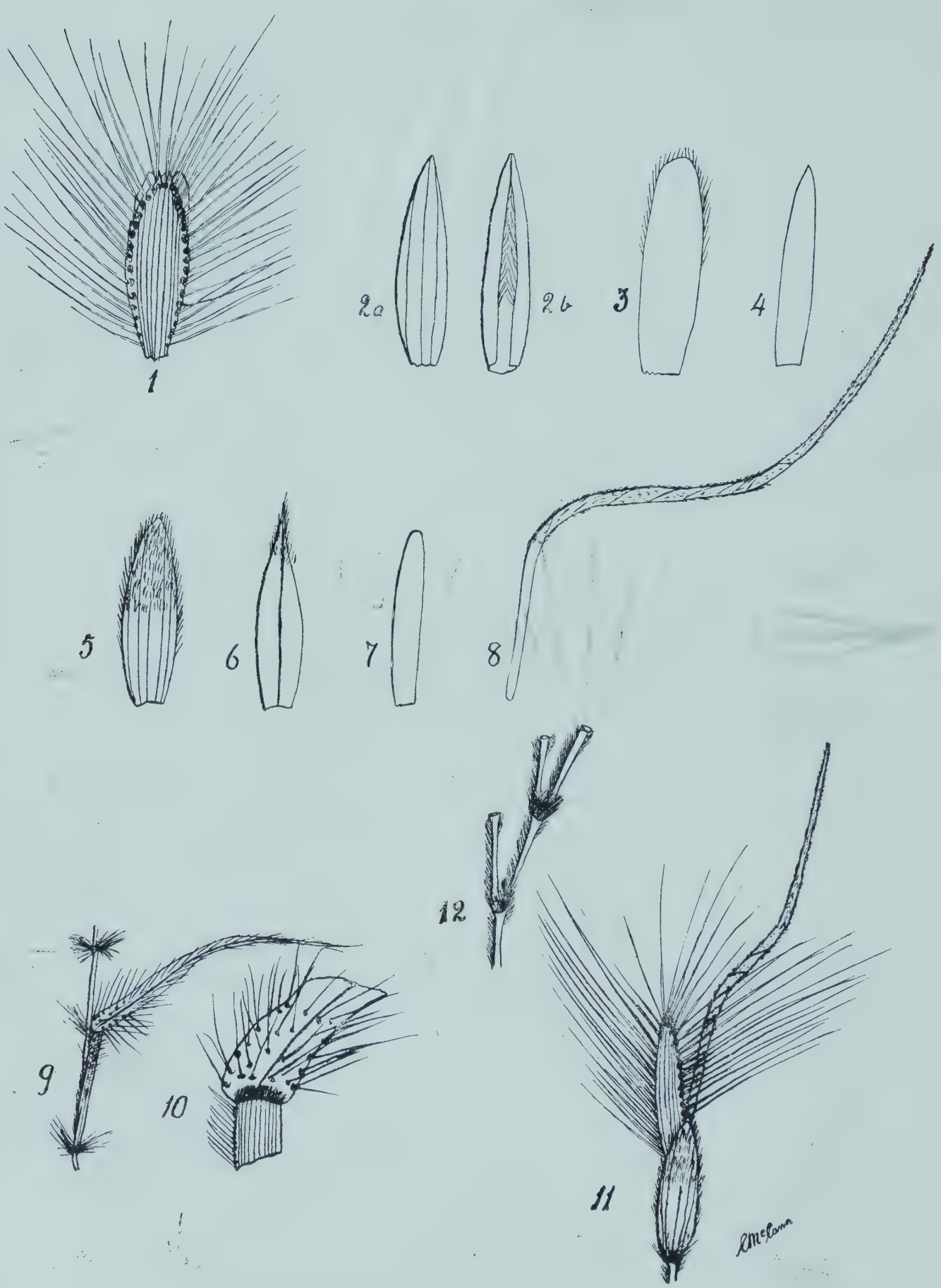
Dichanthium panchganiense, Blatter and McCann, *sp. nov.* 1. Inflorescence. 2. Internode and leaf. 3. Upper part of leaf. 4. Ligule and lower part of leaf. 5. Sessile spikelet. 6. Lower involucral glume of s.s. 7. Upper involucral glume of s.s. 8. Lower floral glume of s.s. 9. Part of upper floral glume of s.s. 10. Pedicelled spikelet. 11. Lower involucral glume of p.s. 12*a*. Upper involucral glume of p.s., ventral side, 12*b*. Dorsal side. 13. Lower floral glume of p.s. 14. Upper floral glume of p.s. 15. Awn. 16. Part of awn. 17 and 18. Anthers. 19 and 20. Pistil. 21. Sessile and pedicelled spikelets.

Text for Plate 2

Dichanthium McCannii, Blatter, *sp. nov.* 1. Lower involucral glume of pedicelled spikelet. 2*a* Dorsal side, 2*b*. ventral side of upper involucral glume of p.s. 3. Lower floral glume of p.s. 4. Upper floral glume of p.s. 5 Lower involucral glume of sessile spikelet. 6. Upper involucral glume of s.s. 8 Upper floral glume of s.s. 9. Internode and leaf. 10. Lower part of leaf with ligule. 11 Sessile and pedicelled spikelets. 12. Joints and pedicels.



Dichanthium panchganiense, BLATTER AND MCCANN. SP. NOV.



Dichanthium McCannii, BLATTER, SP. NOV.

GAME PRESERVATION IN INDIA

BY

THE EDITORS

Game Preservation wherever it may be undertaken embodies the same principle—the principle that, in order to afford game animals that peace and protection which will enable them to live and reproduce their kind without damage to man, man should only be allowed to damage them under certain rules and should be restricted from ruthless destruction. How is this principle applied in India?

Let us take first the factors which adversely affect the existence of game and then consider the remedies or lack of remedies.

The prime factor adversely affecting the existence of game is MAN. Man affects the existence of game in two ways; firstly as a settler, by clearing the forest and waste lands and driving the game away from its natural habitat; secondly as a destroyer, by protecting his own preserves from intrusion yet pursuing animal life within the fastnesses of its retreat. Disease is a second adverse factor to be reckoned with; rinderpest has accounted for a large number of bison and buffalo in Peninsular India, while foot and mouth disease has in recent years seriously affected game animals in Kashmir and the Himalayan ranges. A third adverse factor might be said to be the killing of game by predatory animals, yet this factor we might set down as a natural check on over-increase, and unless the balance of nature has been upset by extraneous causes its effect on game as a whole is not considerable. The remedy against man would appear to be obvious, namely the provision of extensive areas of absolute wilderness affording harbourage to wild life, and so long as there are refuges safeguarded by their very nature against usurpation by man so long will wild life thrive and maintain its existence, provided there is no epidemic disease. In India the possession of such areas has been one of the main factors tending to the protection of its wild fauna and there should be little danger, for the present, of any of the existing species being exterminated.

Viewed as a whole, therefore, the present condition of game in India would appear decidely good—but for how long will this status be maintained? In some parts of the country, as in the Central Provinces, there has already been serious depletion and in other areas there is an almost complete disappearance of game.

In making a plea for the protection of the wild fauna of the country we must urge that apart from the purely sympathetic motives which should impel man to permit to lesser creatures the right of existence there are other, perhaps less worthy and more material, thoughts and motives which are worth considering. These reasons are put forth on the assumption of course that animal life is worth preserving *somewhere*.

From the scientific standpoint there are innumerable investigations —anatomical, physiological, ecological, geographic, taxonomic and evolutionary, which can only be made from the study of animal life. Biology has already produced many conceptions of practical and educational value. The role of the parasite, the predator, the scavenger, in the economic web of life has, besides its purely educative significance, a not wholly useless application to social relations.

And what about the purely economic aspect? Even predatory animals have a distinct value as a controlling influence against over-population by species whose unrestricted increase would adversely affect the interests of man. Again there is the utilization for man's benefit of animal products, such as furs, hides and horns, which in themselves present a valuable economic asset and are in themselves a plea for the conservation of the sources of supply. Have these economic possibilities been exhausted? A few years ago Insulin, that priceless boon to the diabetic, was discovered in the liver of a shark. Who knows what animal products yet remain to be discovered which will be of priceless value to man?

The principle of conservation being admitted, what are the methods to be employed? The principle is the same in every country, the methods to be employed must vary in every country and will probably vary in different parts of the same country.

Let us consider some of the different methods of conservation in vogue in different parts of India.

In the United Provinces shooting rules close and open shooting blocks for alternate fortnights. This system provides and ensures fortnightly periods of constantly recurring rest. In the Terai type of jungles, where shooting blocks are small and game can be very thoroughly disturbed by a line of elephants beating them day after day, the system is an absolute necessity.

In the Central Provinces the forests are parcelled out into shooting blocks usually of a large size. One block, usually a central one, being reserved as a Sanctuary; this, coupled with the extensive size of the blocks, secures game from undue disturbance. There is here, and in other parts of India also, a strict limit to the kind and number of animals which may be shot in a given block, and, in addition, an individual limit is imposed on all sportsmen, whether exempted from permits or not.

In Southern India the game laws are not applicable to the various provinces as a whole and in certain areas no game laws exist. The Nilgiri Districts and those parts of Coimbatore and Malabar which are so effectively controlled by the Nilgiri Game Association are the only areas with special laws excepting the areas known as reserved forests where the number of animals that may be shot is controlled by license.

The position as regards game in Assam is simple; here the game areas are divided into waste lands, reserve forests, and hill forests. The immense areas of waste land which existed at one time are now being rapidly cultivated by immigrant settlers or used as grazing lands by an invasion of buffalo-keeping Nepalese, so that game in these lands is rapidly losing ground. In reserve forests shooting is

controlled by license. For the better protection of rhinos, large areas of grass and swamp land have been included in these reserves and treated as sanctuaries. In the hill forest areas conditions are steadily approaching those obtaining in waste lands where an increasing human population is gradually driving game from its quondam preserves. Whilst game in Assam will be less and less exempt from molestation as cultivation approaches forest boundaries, it must be admitted that there is little danger of game in Assam becoming extinct for a great many years so long as extensive forests continue to exist and to provide safe harbourage to game.

The conditions prevailing in Assam may be applied to India as a whole. On broad principles land may be classified in three main zones—urban areas, agricultural areas, and forest and waste areas. As far as animal life is concerned we cannot expect its preservation in urban lands. Cultivated areas with their domestic animals and crops provide at once an opportunity for a conflict between man's interests and those of the wild species, and in such land the plea for protection cannot carry weight. We come finally to forest areas and waste lands where, as shown, excellent laws suited to local conditions have been framed for the protection of wild life yet nevertheless game is decreasing where once it abounded.

Existing game laws are excellent in themselves but it is in their efficient application that the trouble arises. As far as the agency of man is concerned there is no mystery attached to the causes of trouble. Firstly while the license holder is restricted by the terms of his license from doing undue damage, the poacher is affected by no law. He slaughters indiscriminately everything that he sets his eyes upon, regardless of sex, age, or season, he sits over salt licks and water holes, indulges in night shooting and does all that he should not do. Secondly emphasis must be laid on the great increase in recent years in the number of gun licenses issued which increase is producing, and will continue increasingly to produce, its inevitable effect on game in forest areas and lands immediately adjoining. Thirdly there is a mass of unlicensed guns carefully concealed but constantly used, and there is also the loaning of fire arms by accommodating licensees to friends and retainers, and finally there are the professional trappers and gangs of men with dogs who slay and devour all that falls before them. Those in control of forest areas cannot be altogether exonerated for the ineffective application of the rules. Conservators of Forests and Divisional Forest Officers are not necessarily interested in game preservation, and in addition there often exists the clash of interests between the sylviculturist and the game protector, for game can do considerable damage to young teak and other valuable forest timbers.

If the game in reserved forests and sanctuaries is to be protected a more rigid application of the laws is necessary—the stimulus for which might be obtained by an executive order from above. Much might also be effected by co-operation with the police since every constable is in law 'a forest officer.' A more liberal system of rewards for the detection of forest crime, particularly of poaching, is another point worthy of consideration.

Rewards are far too rarely given and very rarely indeed in poaching cases; the detection and capture of a poacher who is armed often involves danger and there is no class of forest crime the detection of which merits to a greater extent the granting of reward. It is evident that much of the poaching that is done in forest preserves is carried on for profit. It is significant that the decrease of game in certain areas has corresponded with the increase in the export of skins, principally of bison, buffalo, sambhar, etc. Bison, chital and sambhar hides are openly sold in the bazaars and there is nothing to prevent these sales. If the poacher is deprived of his market the temptation to kill would be largely removed and it would appear that there could be no possible objection to a general law throughout India forbidding the sale by unauthorized persons of any portion of big game animals—whether hides, horns or meat and with adequate penalties annexed for those who break the law.

As to the question of gun licenses, it may be assumed that in 99 cases out of 100 they are not obtained for the purpose for which they are granted as it is the merest fiction to suppose that the guns are used exclusively for crop protection, which is the only legitimate purpose to which they can be put. While the reduction in the number of licenses may perhaps be a difficult matter, it would seem a perfectly fair proposition to have all the 'crop protection' guns called in during the hot weather when there are absolutely no crops to protect. It is during the hot weather, when water is so scarce and the jungles are so thin, that 80 per cent of the damage is done. It has been found useful, where gun licenses are required solely for crop protection purposes, to have several inches of barrel removed. Lastly a suitable penalty might be imposed for the use of a gun except by the license holder in person.

The formation of suitable game sanctuaries has been proposed by many as a solution. Game sanctuaries to be effective must fulfil the following conditions: They must be fairly large, must possess a perennial water supply and must as far as possible be protected against fire and, what is most important, they must have a special staff to look after them. Each preserve will require well-paid watchers with a game warden over them—the game warden should be well paid and given considerable preventive powers. The case for the game warden and his special staff is that many forest officials have neither the time nor perhaps the inclination to apply themselves especially to game preservation. The exploitation of timber and forest produce is annually increasing and forest officers find it more and more difficult to get away from work which brings revenue so as to be able to pay sufficient attention to a question which in this material age is considered to be one of subsidiary importance. A game warden requires special qualifications and besides being a sportsman must also be a naturalist with a knowledge of the ways and habits of the animals he is called upon to protect. The objection to the game sanctuary is that it is expensive both as regards the extent of forest land which must be sacrificed for the purpose and as regards its maintenance by a well-paid warden and an unbribable staff. Besides it may be maintained that a long period of protection in the same area is probably a mistake.

Nullahs maintained as sanctuaries in Kashmir for considerable periods were found, on reopening them to shooting, to be almost empty of game. Lastly an 'unbribable staff of subordinate game watchers' would be difficult to procure. The Nilgiri Game Association which, at considerable expense, maintained a staff of seventeen game watchers, abolished the system as these were found to be quite useless and their duties have now been taken over by ordinary forest guards.

The whole question of game protection and the tightening up of the laws affecting it is in the main a question of money. The formation of a special game protection fund in the various provinces might be well worth considering. The fee for shooting in the splendid jungles of the Central Provinces is Rs. 9 per mensem. This paltry sum is to cover the cost of a special guard who often acts as a sort of orderly to the permit holder. Game protection is of interest to the sportsman and it is right that he should contribute towards it. Shooting blocks might be classified as (*a*) the very highest class, (*b*) good blocks, (*c*) poor blocks. The permit holder might be charged Rs. 1-8-0 per day for (*a*), Re. 1 for (*b*) and annas 8 for (*c*). When one considers what people have to pay for sport in other parts of the world, this is not a suggestion that would be seriously opposed even in India where only the poor reside. In addition a special charge might be made for shooting bison, buffalo and the more sought-after species of game. The money raised by these means should be earmarked for game protection. The formation of such a fund might be sanctioned by the Local Governments and applied for the purpose of supplementing rewards to forest guards, to paying informers, poisoning wild dogs and vermin, killing crocodiles in jungle pools, improving scanty water supplies, etc., in fact all measures which might be helpful to game. It would be a simple matter to calculate by a perusal of the permits issued in past years what sum the proposed scale of fees would bring in in a given district. Whilst the measures proposed above might not maintain wild life at its present level they would, we consider, have a beneficial effect and help to retard the process of depletion now going on.

The above article was written originally for publication in the *Times of India*. As it proved too long for the purpose the Editor of the Times published a resumé in a leader which appeared in the paper on July 7.

The following note appeared in the *Times*, London, July 12, in reference to the leader published in Bombay :—

'Any further proposals for preserving game in India as suggested in Bombay are likely to be viewed with the greatest suspicion and disapproval by the cultivating classes. Large game is already carefully preserved in many of the Indian States whose rulers are usually ardent shikaris, and in British India the Forest Department controls most of the game areas. In these, shooting is restricted by the issue of licences and the number of heads that may be bagged.

The depredations of the larger beasts are one of the most serious handicaps that the ryot has to face. Hundreds of thousands of plough and milch cattle are carried off every year by tiger and

panther, while the number of human beings who fall a prey to man-eaters is still very considerable. Only last year a man-eater was at large within 50 miles of Madras and was reported to have killed six persons.

Besides the loss of cattle there is the damage done to crops, which in many parts of India is very extensive. Wild elephants are well known as the most destructive of creatures. They will tread down or tear up three or four times the area they eat of such favoured delicacies as cardamoms. It is usually permissible to kill them when they are found doing damage on private land, but it is no easy task to do so. Occasionally a small owner at the foot of the hills may make a lucky *coup* by digging an elephant pit in his land and capturing a small tusker which is worth more than his field, but in an ordinary way the elephant is looked upon as a sacred nuisance. Wild pig do a great amount of damage to sugarcane, and many a weary cultivator spends the whole night on a "machan" among his canes trying vainly to scare them away with horn and tom-tom.

One of the most popular of the provisions of the new Arms Act was the reduction in fees for the possession of muzzle-loaders for the protection of crops and the greatly increased facilities for obtaining licences given to the agricultural classes. Previously, when the losses of cattle from tiger or panther became intolerable and there were no guns available, a whole village would turn out with spears, sticks and drums and surrounding "stripes" or "spots" after his meal, would literally poke him to death.

The cattle mortality returns show no such decrease among them as would justify any further protection of the felines. In fact in the last few years an increase in the number of tiger has been reported in the Godaveri Agency.'

Game Associations

There are already in existence several game associations in the hills which regulate the number of shooting licences issued in the area they control. The Nilgiri Game Association which has been in existence for many years has done very useful work in protecting sambur, bison, etc., and has also spent quite a large sum in stocking rivers with imported trout. Pulni Association, started about 15 years ago, is doing similar good work. Both associations work under the auspices of the Local Government.

So long as the innumerable jheels of Northern India and the tanks of the south receive their supply of water there is no fear of any diminution in the myriads of duck and teal which flock to them every cold weather. The Indian is not likely to change his food supply, and so long as he grows paddy so long will the opportunities for snipe-shooting which India affords be unequalled elsewhere.

As cultivation in the dry tracts increases, it is inevitable that the herds of black buck and chinkara which roamed over the waste lands in former days should diminish, but there will always be uncultivable areas which will form a refuge for them as well as for partridge and sand-grouse and the innumerable other small game of the Indian plains.

The days are yet far off when anything in the way of a National Park to preserve Indian fauna is either called for or practicable. An extract from the petition of a ryot sums up the present situation :— ' A reserve forest in the proximity of the village is the nursing ground for all sorts of forest beasts, particularly that species of animals that exist by the wild destruction and hasty consumption of the crops of innocent but hard-working farmers. No human endeavour, however ingenious, could scare them away ; but if done they come with renewed vigour and far more formidable companions. The declared enemies of the farmer, the cheetas, the leopards, undertake a perfect crusade against my sheep and goats, more particularly my life-giving bulls and other cattle.'

EDITORIAL

We have to apologize to members for the long interval which elapsed between the publication of Part 4 of Volume XXXI and Part 1 of Volume XXXII. The delay was due to unfortunate labour troubles in Madras and we congratulate both the management and the men on the termination of the strike. We hope such troubles will not occur again and we have the management's assurance that they will be able to print another journal—a successor to this—before the end of the year. If they are able to do so, we as Editors shall have fulfilled the contract the Committee set themselves out to perform, namely the placing in member's hands of four Journals in a year. The Society's prospectus states that the Journal is brought out as near quarterly as possible but this must be modified, and modified not because of recent happenings in the Press but because of the want of material for the Journal. We want more Miscellaneous Notes. We want members who have been on big game expeditions, or have made a study of the fauna or flora of a particular part of India or in neighbouring parts to share the results of their labours with, and relate the story of their travels to, other members of the Society and we want the medium to be the Journal. We will provide, free of cost, copies of the article for the author's private distribution and we welcome illustrations and are willing to publish as many good illustrations as we receive. This brings us to the question of the quality of a good many of the illustrations we produce. We do not know what members' opinions are but for ourselves we are not satisfied. We ought to produce better results. Is it the fault of the Indian block maker? or of the art paper? We try to be patriotic and in India support Indian industries. We print the Journal in India and in consequence have to pay duty at the rate of 30 per cent on cost should we print our illustrations at home and bring them out here for insertion in the Journal. If however we were to print the Journal at home there would be no duty to pay on the illustrations. They would then be part of a book and books are admitted free of duty. It is only if you print in India that you pay duty on the paper and the type used in producing the book.

This again brings us to the subject of books. By the time this Journal is in members' hands there should also be in the hands of many of them the fourth edition of Col. Wall's *Poisonous Terrestrial Snakes of our British Indian Dominions* and the first edition of Col. Evans' *Identification of Indian Butterflies*. As regards the former, the third edition has been out of print for a long time now and the issue of the fourth edition will meet a want. One is always liable to come across snakes in India and it is a good thing to have by one both Col. Wall's book and the chart. With these two the veriest tyro can tell whether a snake is poisonous or not and if poisonous can tell exactly what species the snake is.

We are glad to see Col. Evans' work on the Butterflies of India in book form. It seems a long time since the present Honorary Secretary asked Col. Evans to write a child's guide to butterfly collecting in India and it seems a long time since those early interesting and instructive pages appeared. The plates which have been published in eleven parts of the Journal have undoubtedly been prized, appreciated and looked out for but the pages of description—full of necessary abbreviations and without glossary or explanation have—with all apologies to the writer—looked deadly dull to the non-entomologist. Illustrations, keys, introduction, glossary and simple explanations now appear together in one book and the man who knows nothing can cease from caring less and by the aid of Col. Evans' book interest himself in identifying butterflies which he has seen for years but has not troubled—because it was a trouble—to find out the name of. We take this opportunity of thanking both Col. Evans and Col. Wall for the trouble and care they have taken over the publication of these books.

We are getting on well with the painting of the plates which will, in addition to providing the charts illustrating the Common Birds of the Plains of India, illustrate the book on the Common Birds of India we hope to issue next year. We shall give coloured illustrations of no less than 210 birds and by means of three colour or offset method of reproduction and using the same block for both book and chart illustrations, we are confident we shall achieve what has hitherto been regarded as the impossible and produce a cheap well-illustrated popular book on the Common Birds of India.

It will be in all probability a year before the book is published and we would



NEST OF THE GREAT INDIAN HORNBILL (*Dichoceros bicornis*).

Photograph of a nesting group in the Natural History Section, Prince of Wales Museum.

ask members not to be impatient. We hope that this year we shall see the publication of Mr. Whistler's book on Indian Birds, a popular work in the publication of which our late Honorary Secretary, Mr. W, S. Millard has interested himself. We also learn that the Madras Government propose to issue a book on the Common Birds of Southern India, the authors of which will be Messrs. C. M. Inglis and Major H. R. Baker.

THE NATURAL HISTORY SECTION OF THE PRINCE OF WALES' MUSEUM

As members are aware the Society has accepted responsibility for the working of the Natural History Section of the Prince of Wales' Museum in Bombay and the exhibits there are the property of the Society, being the gift either of members of the Society or paid for out of monies so provided. The staff is for a large part paid partly by the Society and partly from funds provided by the Government of Bombay. The administration under the Trustees of the Museum is conducted by a special Board of three Trustees, two of whom have been appointed by the Committee of the Society and the third elected by the Museum Trustees from amongst their own number. Members therefore have an interest in the finances of the Natural History Section of the Museum and for their information we give the following extract from the Annual Report of the Section for 1926–27 :—

Government Grant. The maintenance and operation of the Natural History Section for the fiscal year from April 1, 1926 to March 31, 1927, were provided for from the grant of Rs. 23,500 received from the Government of Bombay. The opening balance at the Bank on April 1, 1926, amounted to Rs. 4,411-7-8, the income during the year from interest and other miscellaneous receipts amounted to Rs. 678-11-5.

In accordance with the terms of agreement existing between the Natural History Society and the Board of Trustees, Prince of Wales' Museum, a contribution of Rs. 10,537-8-0 was made by the Society being the half cost of the salaries of the Curator and Assistant Curators.

Income and Expenditure. The total income of the Natural History Section for the period under review amounts to Rs. 28,590-3-1. The disbursements may be classed as follows :—Establishment, including Board's contribution to the Provident Fund, Rs. 20,941-13-0, Taxidermy Department Rs. 967-14-3, Show Cases and Equipment Rs. 978-4-0, Miscellaneous Charges Rs. 1,694-14-2, Curator's Deputation to America Rs. 2,500, Collecting Expeditions Rs. 139-2-0, making a total expenditure of Rs. 27,221-15-5.

It will be noticed that only Rs. 978-4-0 has been spent on Show Cases and Equipment and Rs. 967-14-3 on Taxidermy. Well, the Curator works wonders with very little money but even he and his staff could not have prepared the exhibits of the past twelve months on an expenditure as low as that shown.—The help given by Vice-Patrons of the Society is not shown in the preceding statement which apart from the Society's contribution to staff salaries only shows the monies contributed by Government and interest, etc., thereon.

Most of the activities of the Section in the past year have already been commented on in our Journal, either in the Editorial or in the reports of our meetings. In the present number under the latter heading appears a reference to the first of the four group cases illustrating life zones in the Indian Regions, i.e. the desert, rain forest, high altitude and plains. The groups are to be built on the lines of a diorama with curved painted backgrounds. This mode of scenic representation is being generally adopted by the more advanced museums in Europe and America as a direct means of arousing interest of the visitor and thereby more effectively instructing him. By a combination of transparent and opaque painting, of transmitted and reflected light and by contrivances such as screens and shutters a diversity of scenic effect is produced. Besides illustrating the fauna and the flora of given areas these groups will illustrate typical Indian landscapes which will give the visitor not only the idea of the diversity of animal and plant life of the country but also of its diversity of its scenery. We have also referred in a previous Journal to the group illustrating the nesting habits of the Great Indian Hornbill. As the father bird employed in feeding the mother and her young, is no other than the mascot of the Society who for over twenty-five years played cricket behind the Honorary Secretary's chair and extolled the advantages of a life spent in total abstinence from the consumption of water, we publish an illustration of the nesting group.

The annual report also refers to what has been done to interest visitors to

the Museum in Reptiles. Instead of being content with exhibiting representations of snakes, the Curator is working with the idea of illustrating the habits of snakes. The viviparous snakes are represented by a Russell's Viper with its new-born brood of thirty-four young. The oviparous snakes by a Cobra which is seen occupying a deserted ant-hill; the snake is shown with its clutch of eggs. An inset shows the development of the snake from the earliest stage to the time when it is ready to free itself from the egg chamber with the aid of its egg tooth. The third case illustrates how snakes poison their prey. The Saw-scaled Viper or Phoorsa is shown in the process of swallowing a Desert Gerbille. A dissection showing the poison apparatus of the snake and the models of the type of fangs and a unique photograph showing a drop of poison emerging from the tip of a Russell's Viper's fang complete the lesson which the case tends to teach. The plants, grasses and other accessories to these groups have been beautifully reproduced in wax and lend greatly to their attractiveness and interest. Full explanatory labels in English and Marathi have been used in connection with these cases.

An acquisition to the series of exhibited Insects is the new case illustrating House Flies and Disease. A very beautiful model of the House Fly was presented to the Society by Mr. F. V. Evans—one of its Vice-Patrons. This has been introduced into the case and supplemented by models of the eggs and the larval and pupal stages of the fly prepared in the Society's laboratory. While a fly-ridden tray of sweetmeat shows better than words can one of the means by which the germs of disease are carried by flies to man.

Mr. Prater has been ably backed in his work by his assistants—Mr. Salim Ali has increased the reputation of the Society by the educational work he is doing in our schools. Mr. McCann seems to imbibe ideas on modelling as though he were still imbibing his mother's milk and though Mr. LaPersonne is having a respite from travelling and congratulating himself on no longer being in Eastern Persia, he is thinking with envy of the fortunate American Naturalists who are to make a collecting tour in Nepal next cold weather.

It is rather a reflection on the British in India that the best and most representative exhibits of the Fauna of India should be found—not in Indian Museums and not in English Museums but in American Museums. It is not the American Government which puts the American Museum in such a favourable position and there is no need for the British or Indian Governments to do what the American Government does not do, but the American Museums are able to do things because the people of America take an interest in the work the Museums do, and so find the money. American Museums one might say have all the money they can spend. What a difference to India: Were it not for the Government of Bombay we should have no Natural History Museum for the public (it is no argument against, that but for the Natural History Society the Government would have had no Museum to spend money on!). The Natural History Society provides—thanks very largely to its members—the material and the supervision, but raw material is no use without money to turn it into interesting and instructive exhibits and unfortunately the individual in India does not consider there is any call upon him to provide funds for Natural History Museums. One reason of course is that in America there is money and in India, according to the politician, there is none. Is another reason lack of appreciation of existing Museums? Would people interested in Natural History subscribe towards the cost of exhibits if they knew that not only would the exhibits vie with those in American Museums but also knew that the exhibits provided out of their money were housed in a Museum built for the purposes of a Museum—built to serve the purpose it was intended for—built by the architect to meet the requirements of the curator, the architect building and elaborating on the plans of the man who has to make use of the building? We hope to deal more fully with this in our next issue but what a difference we foreshadow!

We publish in this issue the Memorandum and Articles of Association necessary to enable our Society to be registered under the Scientific Societies Act of 1860. We shall be very grateful to members if they will post us their consent to the proposed articles as early as possible and also any suggestions which they consider will be of help to the working of the Society.

There is a flaw in our constitution, or in our management, or is it that the spirit of co-operation is lacking amongst our members?

We ought to have branches, local meeting places, places where up-country

members could meet and where members experienced in Natural History conditions in India can give practical assistance to the young member, beginning his career in India. We want Field Naturalists' Clubs, affiliated to or part of this Society in every important cantonment in India. We want each member to be as keen on getting fresh members for the Society as he would be to put his best pal on the real thing—and a certainty which will benefit him and his friend the more, the more friends he induces to go for the dead cert. You can't do such a thing on the Race Course but you can in this Society, but what do we find?

Many years ago—when Sir Henry McMahon was A.G.G. at Quetta—a Quetta Natural History Society was started and was not affiliated to the Society. The only link between us is that Quetta has our Journal and the Curator of the Museum received his early training from us. We referred in a previous editorial to the formation of a Nature Study Club or Field Naturalists' Club at Poona, a station close to Bombay. We gave the new undertaking our blessing but it was formed without any help from us and without any reference to us. The idea of a branch or affiliation with the Bombay Natural History Society never seems to have occurred. And now we hear—not officially and not directly, but casually—that Karachi has formed a Natural History Society. Well to this new Society we also give our best wishes and promise all the help we can, but surely there would have been an advantage to all concerned had this new Society been a branch or affiliated in some way to our Society. We propose writing to the promoters and putting this query to them but whatever the answer may be it will still leave, as an unsatisfactory blot on the Society, the fact that new Natural History Societies are started in India without any one thinking it worth while to consult the Bombay Natural History Society. When new associations for the encouragement of the study of Natural History are formed, one would imagine that those approached are those people resident in the locality who are interested in the Fauna and Flora of India. Are none of these members of our Society? If none are—what is wrong with us—why have we failed to attract them? If they are members, why have they failed to link up the new Society with the old or rather why have they failed to make any attempt to do so? What is wrong? Something must be, and we appeal to members to tell us. The Committee are not composed of pachyderms neither are they composed of those who are missing the seventh skin and cannot bear criticism. They are the members' representatives and it is up to the members to let their representatives know what is wrong with the structure of the house and the mentality of those who look after it.

We said we wanted each member to be keen on getting new members—we have issued this appeal time and time again. We pointed out that last year we had obtained 204 new members and lost ninety-seven. We asked members to try and better that—there was nothing special about last year's result—no organized attempt to beat up recruits—merely one member or another showing the Journal to friends or telling friends that if they want the results of their skill and shikar turned into trophies, which would for a small sum be a pleasure for life, or telling hard up acquaintances that if they wanted books on Indian Game Birds cheap, they should join the Society. That was all that was done but why is it not being done now? Or if it is being done now why is it a failure? What is wrong? Our failure to publish a journal for five months is not our fault and members will get their quota by the end of the year.

We ask why is it not being done now? and we ask with reason. We have lost through death and resignation this year forty-five members. We have gained 113 new members. Splendid! Yes—compare it with last year and then remember that it is the result—not of the member asking the man who is keen on Natural History to join the Society—but the result of the Honorary Secretary and his staff drawing a bow at a venture and asking men who they know are interested in the progress of India but who may not have the slightest interest in nature, to join the Society. If such requests bring forth good results what might not one expect in the way of results from members asking those who are interested in Natural History to join? There is no necessity for any set form of application but each of the present Journals contains a form and we hope each will be made use of.

MISCELLANEOUS NOTES

I.—TIGERS AND ELEPHANTS

Referring to the note by Prince Victor Narayen on page 1025 of vol. xxxi of the Journal, it is surprising that the Cooch Behar shooting records do not chronicle any case of an elephant being attacked without provocation by a tiger because it is certain that in Assam hungry tigers do kill young elephants.

I have known of a female that was captured, lacerated and weak from loss of blood and exhaustion, standing beside her small calf, which had been killed by a tiger, and there was no doubt that the tiger subsequently attacked the mother when she came up and tried to drive it off.

During two seasons' hunting in the North Cachar Hills we caught four or five elephant calves, which tigers had attempted to ham-string, and we destroyed one in the jungle which had been crippled and deserted by the herd without being finished off by the tiger. The above calves were all 5 ft. or over, and were presumably getting beyond the size most easy for hamstringing. There were, it must be admitted, special circumstances in North Cachar because rinderpest had almost wiped out the wild buffalo, bison and pig, and the tigers must have been hard put to it for food, but it is not unusual elsewhere to find the pug-marks of a tiger that has apparently been following a herd on the chance of being able to dash in and cripple a calf before its mother can defend it. We once cornered a herd of elephants in Kamrup but were unable to drive them with men in the desired direction owing to the presence of a fierce old female and so used our trained elephants for the job. They spent three days trying to drive the wild ones, and on each day put up a big male tiger that was hanging round the outskirts of the herd.

GAUHATI, ASSAM.
May 21, 1927.

A. J. W. MILROY.

[An interesting note on the subject of a tiger attacking elephants by Mr. C. G. Corbett appears on page 119, vol. vii of the Society's Journal. From the number of similar instances recorded from time to time it would appear that in thickly afforested tracts it is by no means an uncommon occurrence for a tiger to hamstring and kill young elephants. It is further interesting to learn from the Annual Report of the Uganda Protectorate Game Department for the year ended December 31, 1925, that the lions in those parts also habitually take a heavy toll of young elephants. EDS.]

II.—TIGERS PREFERRING CARRION TO LIVE BAIT

Regarding the note about tigers preferring carrion to live bait, which appeared on page 1025, vol. xxxi of the Journal, I came across an instance of this a couple of weeks ago. I shot a tiger over the carcase of a bear which had died and been carried off by the tiger in preference to a bullock, tied up for his special benefit a short distance away. There is a bare possibility that the tiger had not seen the bullock, but knowing what the tiger is, I think this is hardly possible. While on the subject, can anybody inform me of what use to the common bear obtained all over the plains of India, is the six or seven inch coat of fur he is provided with?

I have heard the reason given that it was to save him from the stings of bees while robbing their hives. I do not think this can possibly be the explanation. If bees had stings six or seven inches long, very few people would cultivate them!

I shall be grateful for a more reasonable theory.

MAKRI,
KONDAGAON P.O.,
BASTAR STATE, C.P.,
May 6, 1927.

W. H. O. SHORTT.

[The shaggy and dense coat of the sloth bear whose habitat is restricted to the forests of peninsular India appears unsuited to the climatic conditions

under which he lives. While there is certainly some connection between temperature and the range of animals, climatic conditions and animal inhabitants do not always march together, and the distribution of animals cannot be mapped out into the areas bounded by parallels of temperature since there are plenty of cases like that of the tiger, which is as much at home in a tropical jungle as on the icy plains of northern Asia. EDS.]

III.—A PANTHER COMMITTING SUICIDE

I met with a somewhat unusual experience the other day which might interest readers of the Journal. I should also like to hear of any similar experiences of other members.

I was informed early one morning that a panther was sitting near a tank not far away. I went out and found it lying more dead than alive among some rocks. I put it out of misery and then found, on closer inspection, that the greater part of the near hind leg had been eaten away, evidently by the panther itself as there were no marks of a fight of any sort on the body.

On skinning the animal it was discovered that there were a number of pieces of porcupine quill embedded in the flesh, and it was evidently the excruciating pain of them, festering inside the leg, that had made the panther eat away the affected part, although it virtually committed suicide by doing so, as I do not think it would have lived much longer. You may imagine the extreme state it was in when I say there were a score of villagers watching it from about thirty feet distance when I arrived, and it was taking not the slightest notice of them.

I have heard and read of animals biting away a leg caught in a trap, but this would not mean eventual death to the animal, and I cannot understand any animal going to this extreme to rid itself of even the worst kind of wound.

I shall be greatly interested to hear of any parallel experience.

MAKRI,
KONDAGAON P.O.,
BASTAR STATE, C.P.,
April 8, 1927.

W. H. O. SHORTT.

IV.—THE COLOUR CHANGE, AND SEXUAL DIFFERENCES IN COLOUR IN THE LONG-ARMED SHEATH-TAILED BAT

(*TAPHOZOUS LONGIMANUS*)

I have read with interest Mr. McCann's notes on the Long-armed Sheath-tailed Bat, in the recent number of the Journal. (Vol. xxxi, p. 1030).

I do not, however, agree with the suggestion that the young of this Bat are pale fulvescent and become gradually black with age. I am convinced, from my experience with the species in Ceylon, that the opposite is in reality the truth—that is to say, that the young are dark in their first coat and become gradually lighter and more brightly coloured with age, the adult male becoming light reddish-(almost cinnamon) brown eventually.

Out of ten of these bats, all shot from their 'roosts' in the crowns of cocoanut trees, six were males and four females. The males were reddish-cinnamon-brown in four cases and dark grey in the remaining two, both the latter being certainly juveniles, I think.

The females were all four dark grey, with the exception of one—a very large specimen—which had the grey tinged with reddish. And of two others, both females, shot one evening near Kantalai Tank, one, the smaller, was of the usual dark grey type while the other, an exceptionally large one, was of the same cinnamon-brown shade as is seen in the adult males.

I think, personally, that the cinnamon-brown shades (becoming more fulvescent with age) are the usual colour of the adult males, while the dark grey is the usual colour of the females and young but that the adult female may assume the cinnamon-brown shades in old age.

Much the same colour change may be observed in the closely related species, the Black-bearded Sheath-tailed Bat (*Taphozous melanopogon*). The males of

this species would seem to be lighter and brighter in colour than the females and young; and what I take to be the oldest males are again lighter than the general run of males.

In another family of bats—the Rhinolophidae—we also find an analogous case. The young Dekhan Leaf-nosed Bat (*Hipposideros brachyotus*) is, in its first coat, a very dark blackish-brown while the adult has generally a deep reddish-brown coat, which may on occasion turn to bright reddish-or ferruginous-brown. Again this bright colouring is much more common in, but not entirely confined to, the old males.

My own belief, which I have not entirely confirmed yet, is that as a general rule among insectivorous bats, where any differences of colour are found, the young bat is always darker than the adult and that the coat of the adult usually lightens and brightens in colour with age, but that the lighter and brighter shades of colour are assumed at a very much earlier date by the males than by the females.

Mousakande Group,
Gammaduwa, Ceylon.
April 21, 1927.

W. W. A. PHILLIPS.

V.—HABITS OF THE FLYING LEMUR (*GALEOPTERUS PENINSULÆ*)

I have recently had a Flying Lemur in captivity for a week and was able to observe its habits to a certain extent and perhaps the following observations on this comparatively rare animal may be of interest to readers of the Journal. The Lemur was captured by some wood-cutters at Kamounghla, Tavoy District, and through the courtesy of Mr. B. Ribbentrop came into my possession a few hours after capture. Though at first it bit somewhat viciously when handled, the little animal in a very short time appeared to realize the fact that no harm was threatened, and it soon ceased to bite and allowed itself to be handled freely. It proved to be almost if not quite nocturnal, but if disturbed in the day-time could move about freely and did not show any marked dislike to bright sunlight; for the greater part of the day it seemed asleep, either pendant from the branch of the tree I provided for it, or else in a clinging position to the upright trunk of the tree. In either position the head was invariably tucked under the body between the fore-legs and the tail tucked in between the hind-legs, and in both positions the protective colouration of the lemur's fur was most striking and when viewed at even a short distance against a background such as the mottled trunk of the tree, the animal was extremely difficult to discern. It can be easily imagined how very much more effective this protective colouration would be in the dim light of our evergreen forests—its natural home—and the Burmese name of 'Thit Poo' applied to it (meaning literally a protuberance on the trunk of a tree, or a tree knot) rather aptly describes its appearance when asleep. Its movements usually were very slow and sloth-like, and when placed on the ground it proved to be just as helpless as a bat is in a similar position, and not being capable of assuming an upright position could only progress by a succession of short flapping leaps towards the nearest upright object up which it would immediately climb. The animal readily ate ripe fruit and drank milk from a dish, lapping it up much as a dog does, but a variety of insects such as spiders, beetles, grasshoppers, moths, etc., offered it both in the live and dead state were invariably refused much to my surprise. It did not readily eat the small pieces of raw meat offered and apparently the main diet of these animals in the wild state is fruit.

The only sound the animal seemed capable of making was a soft rattle much resembling the sound produced by a pencil-point run sharply across the teeth of a comb. When frightened, this sound was accompanied by a hiss resembling that produced by a snake. The animal died, apparently from some pulmonary disease, a week after its capture.

Hpa In Mine,
Tavoy,
March 2, 1927.

W. S. WOOD.

[The Flying Lemur, also known as the Cobego or Colugo, is one of the most interesting animals of our region. Naturalists have been very puzzled as to its true status; some have placed it with the bats others with the lemurs and others again with the Insectivora. Dr. H. C. Chapman who made a special study of the animal, maintains that it cannot be regarded either as a bat, or a lemur or an insectivore but that it stands alone as the sole representative of an ancient group, the *Galeopithecidæ*. The degree of development of the expansion of the integument by which the creature supports itself in the air, is midway between the bats and the flying squirrels. Not only are its long slender limbs connected by a broad integumentary expansion extending outwards from the side of the neck and body as in a flying squirrel, but there is also a web between the fingers and the toes, while the connection of the hind limbs and the envelopment of the tail in a membranous expansion is comparable to a similar structure in bats. The brain is like the Insectivores. The teeth are peculiar in the singular comblike expansion of the lower incisors. In its food the species appears to be frugivorous rather than insectivorous, as noted by Mr. Wood. EDS.]

VI.—FLYING SQUIRRELS IN TENASSERIM

I am sending for the Society's Museum the skin and skull of a small kind of Flying-squirrel; I caught the little beast alive but could not rear it for longer than a fortnight. It is apparently full grown and extraordinarily small, being only about eight inches in length all over. The tail too is an extraordinary feature resembling a feather rather than the full tail of a squirrel. I noticed that this was always held over the back in true squirrel style. The only other small Flying-squirrel that I have come across in this district is the Striped Petaurista. I remember once giving J. C. Hopwood seven of these latter, and as there were two full-grown squirrels and five small ones I naturally concluded they formed the parents and young of one family. Hopwood afterwards found that they consisted of two mothers one having three young and the other two, and the queer thing is that they were all found in one nest in a bank of earth apparently on the best of terms, and unlike human beings, the two females appeared to have been sharing the same abode in perfect harmony. I cannot say for the male squirrel whether it was a case of two wives as I never met the little gentlemen to enquire.

The Burmans here give rather a peculiar name to the little Flying-squirrel whose skin I am now forwarding. They call it the 'Thimbaw-tha-naya' which means 'the five hundred sailors,' and the legend is that five hundred sailors (of what nationality history recordeth not) landed on the Tenasserim coast somewhere, and saw one of these squirrels and desiring to catch it, the whole five-hundred chased it for a whole seven days but could not effect a capture owing to the squirrel's nimbleness, hence the odd name. I am not too sure that this is the animal the name applies to, as I have heard the same legend in connection with the little striped Palm-squirrel.

TAVOY,
May 14, 1927.

W. S. WOOD.

[The skin sent by Mr. Wood is that of the Pigmy Flying Squirrel (*Pteromys* (*H.*) *belone*) whose distribution is Arrakan, Tenasserim and Cochin China. EDS.]

VII.—ALBINO GORAL (*NEMORRHÆDUS GORAL*) IN CHAMBA

Some albino goral are found in the Chanju Perganah of the Chamba State. They are like ordinary goral except for the colour of their coat which is white. They live at an altitude of 7,200 feet. A pair was noticed about ten years ago and they are multiplying, as six were seen at Christmas 1926 when I was shooting there. I managed to shoot one. It is a good specimen the horns measuring $8\frac{5}{8}'' \times 3\frac{5}{8}'' \times 2''$. These measurements have been recorded by Messrs. Rowland Ward who are setting up the head for me.

CHAMBA,
April 14, 1927.

RAM SINGH,
Raja of Chamba.

VIII.—IS THE LARGE HORNBILL (*DICHOCEROS BICORNIS*) CARNIVOROUS?

I remember in Myitta (Tavoy District, South Tenasserim) somewhere about 1912 watching one of these great birds calmly extracting and swallowing with apparent relish, one by one, an unfortunate brood of young Mynas from a hole in a tree, while the irate parents vainly endeavoured to drive him off by clinging to his head and pecking him. The Hornbill paid not the slightest attention to this somewhat rough treatment but carried on until he had disposed of the whole brood. The Hornbill was most methodical in his procedure. He would extract a young bird, beat it on the branch of the tree until its struggles ceased, throw it up in the air and catch and swallow it. I was quite close and I noticed that the young Mynas were just getting their feathers. The question arises is this a common practise among Hornbills? or is it a case of individual degeneracy? If it is the former, the Hornbills must do enormous damage among the young of wild birds and should be indicted along with the birds of prey and other nestling destroyers.

TAVOY,
May 14, 1927.

W. S. WOOD.

[Lt.-Col. A. Newnham, I.A., recorded on p. 263, vol. xxi of this Journal the instance of a Grey Hornbill (*Lophoceros birostris*) extracting and devouring young paroquets from a nest-hole in a large siras tree at Jullunder.

A specimen of the species referred to by Mr. Wood which lives in the Society's rooms once caught hold of a rat that had ventured into its cage and was proceeding to dash it from side to side, no doubt with the intention of ultimately making a meal of it, when the squealing victim somehow managed to free itself and to make good its escape. On another occasion a half-grown pigeon was unfortunate enough to transgress into the hornbill's domains and was promptly seized and battered to death against the sides of the cage. The bird was too large to be swallowed and was therefore dropped on the floor. EDS.]

IX.—A JUNGLE FOWL PROBLEM

I was wandering through a shola bordering my estate in April last year and found a portion of the shola was simply alive with Jungle Fowl (hens) and their young chickens. I saw no cocks, but hundreds of hens flew up into the trees and there seemed to be myriads of baby chicks on the ground. While I moved the latter kept extraordinarily still, not a leaf stirred; but if I stood perfectly still for a few minutes they would slowly start moving forward again and the air was full of their little 'cheep,' 'cheep,' 'cheep.' There seemed to be a belt of hens and their chicks moving down the shola, about fifty or seventy-five yards wide. Can you account for this strange congregation of Jungle Fowl?

HONNAMETTI ESTATE,
ATTIKAN P.O., *via* MYSORE,
April 5, 1927.

RANDOLPH C. MORRIS.

X.—A LOST SNIPE

On March 19, 1927, I was shooting with a friend, B. down a small tributary stream of the Haro River between Hasan Abdal and Haripur. We were accompanied by a local shikari. The stream consisted of a chain of still pools connected by small runs.

A Full Snipe rose and we dropped him, winged, into the middle of a pool. The pool was some fifteen yards in width by about forty yards long. We advanced to pick the bird up, providing ourselves with a long stick for the purpose as he was lying some seven yards from either bank and the pool appeared some feet in depth. As we approached our attention was temporarily diverted by two snipe passing overhead. They flew well out of range and I paid them little attention. At the most I had taken my eyes off the pool for

fifteen seconds when I looked at it again and saw that the wounded Snipe had completely disappeared. Had it had time to swim to either bank—it certainly had not—it would have found no cover. The pool was bounded on one side by a smooth perpendicular cliff and on the other by an open mud beach covered only by a few pebbles. There were no surface weeds. The current was negligible. A careful search convinced us that the bird must have been quickly drawn under by a fish.

These pools, I know, contain murrel. The shikari, a reliable local man, told us that the murrel hereabouts run up to seven or eight pounds. The water looked too small to hold anything bigger.

Turtles abound in the Haro River. I have seen no traces of them in this particular stream the nature and size of which seem to eliminate the likelihood of a turtle being the thief.

Just before our attention was diverted to the flying snipe, both B. and I noticed that the wounded bird made two quick attempts to jump. I believe it to be most unusual for a winged snipe to try to rise from open water. Perhaps in this case the snipe saw the fish rising towards it from the weeds at the bottom. The water was clear.

Isn't a murrel usually slow to make up his mind to feed and shy of approach? In this case the thief, whether fish or turtle, was neither one nor the other.

SRINAGAR, KASHMIR,
April 4, 1927.

R. H. STABLE,
Capt. I.A.

[Mr. T. R. Blackley of the Sudan Civil Service describes in the *Field* of May 12 (1927) a recent experience where he shot a brace of teal right and left, which fell into a swamp. Before they could be retrieved, a hawk swooped down and carried off one bird. After a prolonged search the second was found and when pulled out was seen to have been partially devoured by a fish which continued to hold on tenaciously to its prize even when the teal was pulled out of the water by its legs! The fish is estimated to have weighed about 1½ lbs.

A curious instance is recorded on p. 259, vol. vii of the Society's Journal where a wounded snipe, after a protracted search, was rescued from the jaws of an enormous frog. However, it is very likely that as the pool at which Capt. Stable shot contained murrel, this fish and no other was the culprit in the case.

The murrel (*Ophiocephalus* sp.) feeds largely on frogs that roam about near the surface of the water, and it is probable that while looking for its prey, the fish caught sight of the helpless snipe and lost no time in appropriating it. EDS.]

XI.—'THE ARRIVAL OF SNIPE IN MYSORE'

I read the letter with much interest (No. 11, by Mr. G. V. R. Frend) in vol. xxxi, No. 4, in connection with the arrival of Snipe in Mysore. In this letter he states he shot three Pin-tail snipe in Mysore on August 29, and questions whether they were early immigrants, or possibly birds that had remained over from last season.

In a note by the Editors on this incident, the opinion is stated that these birds were probably 'stay-backs' from the last season—but I should like to state that I do not consider this conclusion to be correct (at any rate as far as the date of August 29 is concerned), and Mr. Frend did not mention that he had obtained any birds before this date in July.

I have watched the north-east migration of birds fairly carefully in the hill districts in Ceylon for some years past, and my opinion is that there is practically always a north-east inclination of the wind (though not always a ground surface wind) some time in August, usually about the time of the full moon, and the first and earliest fore-runners of the various winter migrants practically always arrive in the hilly districts of Ceylon during the period of the August full moon, whenever that occurs. The migrants that appear in Ceylon (though in very few numbers) regularly during August are as follows :—

The Common Sandpiper (*Tringa hypoleucus*).
The Grey Wagtail. (*Motacilla cinerea melanope*).

The Blue-tailed Bee-eater. (*Merops superciliosus javanicus*).
The Brown Shrike. (*Lanius c. cristatus*).
The Pin-tailed Snipe. (*Gallinago stenura*).

In this list the Pin-tailed Snipe occurs, and occasionally the early snipe appear to be young birds with their full plumage hardly matured, though generally I expect the first and early birds to arrive would be disgruntled males, that for some reason or other have not paired properly during the season.

One often hears people state that birds that have been pricked by a shot, do not undertake the arduous migratory flight when the mating 'urge' arrives in April, but my own experience is that this 'urge' is so strong; that whether they were wounded or not, unless the cells of the brain that govern the homing-instinct were affected, they would endeavour to undertake the journey, and would of course fall by the way, more likely than not, a meal to some bird of prey, watching for the weak ones following behind the migratory flight.

KANDY,
April 18, 1927.

GEORGE BROWN.

XII.—ADDENDA TO THE AVIFAUNA OF SIND AND OF BRITISH INDIA

1. Ammomanes phœnicura zarudnyi.

Since I wrote the *Birds of Sind* (*Ibis.*, 1923, p. 19) I have discovered a specimen of this desert form of *A. phœnicura* which was collected by Blanford south of Sehwan, on December 12, 1875. He no doubt obtained it in the hills or foothills of the Kirthar Range and passed it over as the young of *phœnicuroides* from which however the black band across the tail among other differences suffices to distinguish it. Its status is doubtful, possibly a resident possibly an elevational migrant from Kelat. The specimen is in the Tring Museum. This race has been recorded from Baluchistan.

2. Sylvia curruca halimodendri.

A specimen of this pale form of Lesser White-throat was obtained by Mr. Salim Ali at Phulji, Larkana District, on December 22, 1926 and sent to me for identification. I have already recorded this race in Persian Baluchistan but this is the first record in India proper. This race is much paler above than *Sylvia curruca affinis* and is about the same colour as *minula,* however in measurements and wing formula it is the same as *affinis*. Prof. Sushkin has divided these pale White-throats still further and gives as the distribution of *halimodendri* from Zaisan Nor, west to the steppe region north of Aral Sea, while his new form *telengitica* is said to inhabit the basin of the Achit Nor and South-east Altai in Western Outer Mongolia. The only specimens I have examined from anywhere north of India are those collected by Przewalsky in Ala Shan and N. Tibet and these correspond with the description of *halimodendri,* and seem to be quite the same as the Sind and Persian-Baluchi birds and therefore until one can see specimens of *telengitica* I keep them all under the above name.

LOWESTOFT,
March, 1927.

C. B. TICEHURST,
M.B.O.U., F.R.G.S.

XIII.—CORRIGENDUM TO FAUNA OF IRAQ

In the Journal for May 1926 I recorded the jay from Dohuk (Additional Notes on the Birds of Iraq) as *Garrulus glandarius atricapillus;* I have recently re-examined all the jays from Palestine, Asia and Caucasus and I find the Dohuk bird is much nearer the Caucasus one. It is greyer above and below than *atricapillus,* the Palestine bird, and less pure white on the forehead and ear coverts. The Dohuk Jay should stand as *Garrulus glandarius krynicki.*

LOWESTOFT,
March, 1927.

C. B. TICEHURST,
M.B.O.U., F.R.G.S.

XIV.—BIRDS EATING BUTTERFLIES

Mr. Hopwood's letter in No. 3, vol. xxxi reminds me that in the Teesta Valley I once saw a Red-legged Falconet catch and eat a Butterfly. It was a female *Papilio memnon* absorbing nectar from a flower and I was in the act of sweeping a net at it when the falconet swiftly passed in front and left no butterfly for the net to collect. I was only just able to turn my eyes from the flower to the bird in time to see the butterfly's wings fall from each side of its beak as it flew to its perch on a tree to swallow the body.

MUNGPOO P.O.,
via SILIGURI, BENGAL,
March 19, 1927.

G. E. SHAW.

[With reference to Mr. S. F. Hopwood's note on the Red-legged Falconet (*Microhierax eutolmus*) hawking butterflies which appeared on page 826, vol. xxxi of this Journal together with our editorial comments, our attention has been drawn by Sir Peter Clutterbuck to some notes published recently which form an interesting supplement to our knowledge on the subject.

Vol. i, Part ii of the Proceedings of the Entomological Society of London (p. 32) has the following report:

'The Pigmy Falcon capturing Butterflies in Kelantan. The President drew attention to the following observation recorded by Mr. F. F. Laidlaw, M.A., in *Journal 88 of the Malayan Branch of the Royal Asiatic Society,* October, 1923, p. 377:—"Whilst I was at Kuala Aring in Kelantan in September 1899 I was interested to notice on more than one occasion a small party, three or four individuals I think, of the Pigmy Falcon (*Microhierax fringillarius*). These birds used to sit on the higher branches of a dead tree which stood in the middle of a small clearing in the forest close to the kampong. Their occupation seemed to consist chiefly in capturing butterflies, and there was constantly a litter of wings on the ground about the foot of the tree. Amongst them were the wings of *Papilio delesserti* (Guer.), an insect I did not at the time have means of identifying. It was, however, common at Kuala Aring, in fact abundant; and though I am writing from memory more than twenty years after making the observation I am quite sure of the fact."

Mr. Laidlaw's observation supplied interesting confirmation of the notes recorded by the late Col. C. T. Bingham in *Essays on Evolution,* Poulton, 1908, pp. 289-91. Col. Bingham also found that Papilios formed a large portion of the butterflies captured by *Microhierax,* and among them were those of *Papilio caunus,* Westw., a mimic of *Euplœa.* The observations suggested, as did Dr. V. G. L. Van Someren's note in *Proc. Ent. Soc.,* 1923, p. lxi, that the birds referred to discriminated between the *Papilio* mimics and their Danaine or Euplœine models.'

Dr. Van Someren's note referred to above appears as follows: 'A Hawk attacking *Papilio rex* Oberth., at Nairobi.'—Prof. Poulton exhibited a male *rex* with the male of its Danaine model *Tirumala* (*Melinda*) *formosa,* Godm., taken on the same day, January 14, 1919, at Nairobi, by Canon St. Aubyn Rogers, and read the following note written on July 28, 1923, by Dr. V. G. L. Van Someren:—'I rescued a *P. rex* the other day from a small species of hawk—*Accipiter minullus tropicalis* Reichenow—rather strange, particularly as *M. formosa* swarmed in the patch of flowers where *rex* was taken.'

The other notes on the subject to which Sir Peter refers are to be found in Dr. G. D. Hale Carpenter's recently published book *A Naturalist in East Africa.* On page 21 the author records that in a quarter of an hour's watching he counted sixteen little 'Blues,' nine *Atella* (a brown butterfly about the size of the English 'Tortoiseshell'), three sulphur-yellow *Terias* and one *Eronia leda* which resembles the English 'Brimstone', devoured between two wagtails—*Motacilla vidua.* Dr. Carpenter continues: 'But they made no attempt to eat any of the extremely abundant "White" (*Belenois* and *Pinacopteryx*) which were there, and walked about among them without appearing to take any notice of them, nor did they pay any attention to the Danaine *Tirumala mercedonia,* a typically aposematic butterfly, of which numbers were sitting together on a stone on which one of the birds was actually perched. I never saw them pay any attention to the mimetic *P. ridleyanus.*

The total of twenty-nine butterflies eaten in half-an-hour is certainly an underestimate, for often when watching one bird I heard the bill of the other snap, and, giving it a hasty glance, saw that it was swallowing something. If one considers that these birds had been eating butterflies before I had arrived, and were still doing so when I left, it must be allowed that they had eaten probably fifty butterflies! Every now and then one of them got so full that it had to sit still and rest, all humped up, before it had room to begin again!"

After recording a number of similar observations, Dr. Carpenter concludes by remarking: 'If one considers that these birds frequented those same puddles daily, and ate "good and 'earty" for a great part of the day, one cannot understand the arguments of those who say that birds do not eat butterflies in sufficient quantity to have any influence upon them as a selective agent and therefore cannot cause mimetic resemblances.'

Dr. Hale Carpenter's notes are very interesting, and it would appear that the long-held notion that birds do not eat butterflies to any considerable extent stands in need of modification in the light of recent investigation.

However, assuming that these insects *are* preyed upon by birds in sufficiently large quantities to foster mimetic resemblances amongst them, one fails to appreciate the significance of such mimicry when it falls short of affording protective value to the mimic. EDS.]

XV.—A SHORT-CUT BY BIRDS TO THE HONEY IN THE FLOWERS OF *SESBANIA GRANDIFLORA*

[Reprinted from the *Journal of Indian Botany*, vol. v, No. 3 (December, 1926)]

Numerous examples are known to anthœcologists of 'Unbidden Guests'. These, as is well-known, steal from the flowers the store of honey meant for the use of pollinating insects. The result is that the right kind of insects no more pay their visits, with the consequence that the fertilization of flowers is either prevented, or its chances considerably decreased. The effect of this on the seed-producing capacity of the plant is considerable.

A remarkable instance of this is to be found in the flowers of *Sesbania grandiflora,* a plant belonging to the family Leguminosæ, which came to the writer's notice while collecting material for class use. This plant begins to flower in Benares about the beginning of November and continues to do so almost till the end of January. This period happens also to correspond almost exactly with the time when feathered visitors migrate in large numbers to these parts from colder regions, and on closer observation it was found that it is largely these birds which are responsible for robbing the plant of its store of useful nectar, without doing any service in return.

In order to appreciate fully the intelligent way in which these birds carry on their business, it is necessary to give a brief account of the morphology of the flower. When fully developed, the flowers, like those of almost all other Papilionatæ, bear a striking resemblance to the pose of a bird in flight. And it is this resemblance, enhanced as it is by the white colour of the flowers, that appears to be responsible for the Bengalee name 'Bok' (Duck) given to them. The standard is clawed, and in fully opened flowers bends strongly forward in the form of a cowl over what looks like the bird's head. The latter is formed by the calyx-tube surrounding the essential organs and serves for the storage of honey. In the bud-condition, the standard forms a sort of tight jacket round the other petals and jointly with the calyx effectively guards all approaches to honey.

The honey is secreted by a number of glands situated on the inner side of the united bases of 9 stamens around the ovary, and stored in a beautiful bowl-shaped cavity formed by them. The filament of the 10th free stamen fits nicely over a gutter-like groove in front to prevent any drain of the fluid, and forms together with the base of the ovary a partition dividing the honey reservoir into two lateral chambers. The claw of the standard lies vertically over this partition and is of such width that it just leaves two oval holes at the top, simulating the orbits in a human cranium and apparently serving as approaches to the honey.

The interesting point in the stealing process is the fact that the robbers seem to have found out the exact position of the honey passages, and peck holes at

the spot with great deliberation and precision. Out of the many flowers examined by the writer, only rarely specimens were met with, which showed evidences of pecking wide of these points, and these probably represent attempts of foolish or inexperienced birds. Another interesting point, and one which brings the intelligence of these birds surprisingly into prominence, is the fact that only those buds which have developed sufficiently to be able to secrete honey, are sought, the younger ones are apparently deliberately avoided, except in rare instances for which again inexperienced or stupid birds may be responsible.

Cases like these are of immense interest and open up many questions with regard to the intelligence of birds. How is it, for instance that they get to know the particular stage of development at which the nectary begins to secrete honey?; and again how is it that they come to locate exactly the positions of the honey passages in the unopened buds? Instinct and intuition may enable one to understand the habit of birds in approaching the flowers, but they scarcely suffice to explain the wonderfully exact nature of their behaviour in locating the exact points where holes ought to be made, and in selecting only those flower-buds in which nectaries have begun to function.

The following birds have been noticed in the act of pecking the flowers in addition to squirrels, which bite at and destroy flowers in large numbers. But the list is not claimed to be by any means exhaustive, and doubtless there must be other birds concerned.

Psittacula torquatus	...	The Common Parroquet.
Leptocoma asiatica	...	The Indian Purple Sunbird.
Molpastes hæmorrhous	...	The Red-vented Bulbul.

In addition to these the common Myna (*Acridotheres tristis*) and the House Crow (*Corvus splendens*) have also been seen sitting in large numbers on the plant, but the writer has not had any occasion to notice them in the actual act of pecking.

N. K. TIWARY, M.SC.,
Dept. of Botany, Benares Hindu University.

XVI.—ARTIFICIAL AND NATURAL MIMICRY

In the pages of the *Illustrated London News,* dated May 7, 1927, in his contribution on mimetic Cuckoos it is gravely asserted by Mr. W. P. Pycraft that the black Indian cuckoo known as the Koel (*Eudynamis honorata*) foists its young on a kind of crow known as the *mynah.* Now our familiar Indian grey-necked crow is not so black as Mr. Pycraft would have his readers believe nor is he a *mynah.* He is not mistaken as to the identity or nature of the male of the Indian black cuckoo whom he invariably chases away from the vicinity of his nest and as is well-known to every bird observer in India the female koel foists her eggs on a crow's nest by stratagem and not through the supposed mimetic resemblance of her mate to a crow. Nor do the nestlings of the Koel resemble the male so as to deceive their corvine foster parents. The writer has seen crows feeding young Koels in the brown, grey and speckled plumage of the female cuckoo and it is to be feared that the plumage of the male koel, black though it be, does not entitle him to be included as a corvine mimic. It seems to be a besetting weakness in the minds of some entomologists and ornithologists to lump instances of resemblances amongst birds and insects under the category of mimicry. It has been gravely asserted in scientific journals that the markings on the forewings at the great Atlas moths are protective from their resemblance to the head of a snake and also that the great eye-spots on the lower wings of a South American butterfly and a large Indian Saturnid moth are likewise protective from their resemblance to the facial disc of an owl. All such hocus-pocus are instances of artificial or spurious mimicry evolved in the minds of the framers of such hypotheses. It could equally be strongly urged that the sepulchral markings on the thorax of a death's head moth are warning indications to the superstitious entomologist to keep his hands off, and hence of a protective nature to the moth. It may be asked what then is true mimicry as distinguished from the artificial mimicry referred to? To which it may be replied that there are to be seen everywhere in a state of nature tens of thousands of living organisms whose appearance down to the minutest spot and wrinkle is a facsimile of the model that they imitate. Such mimics are veritably living lies and are to be found in the insect world. Stick insects, leaf insects, leaf butterflies and crickets, and perhaps most marvellous of all

are those insects that resemble the white droppings of birds so closely that one's first impression is that a bird dropping has suddenly become alive and is moving over a rock. It cannot be; our eyes must have deceived us, but presto! the bird dropping moves again and then we feel quite sure that it is really an insect. Just a flat patch of white on a stone about the size of a three penny bit of an oval shape and of a pure unsullied white. The Indian oakleaf butterfly is likewise a marvellous mimic but only when at rest. The general outline of the closed wings is that of an oblong acuminate leaf, the elongated tail of the hind wing corresponding to the stalk of a leaf with mid-rib running through the centre and terminating in the apex of the forewing. Countless other instances could be given by every observer who gets his knowledge of nature not from books but by observation, but who on the other hand must not strain facts to fit in with some hypothesis evolved from the mind. It was well said by a great writer that the world is full of clues, and that if a man's mind is sharp set on any quest, he notices and takes advantage of what otherwise he would miss. This is specially applicable in the study of animal life.

BOMBAY,
May 27, 1927.

H. JOUGUET.

XVII.—A LIST OF SNAKES AND LIZARDS FROM PANCHGANI

Through the kindness of Rev. E. Blatter I received the following snakes and lizards collected by him during his stay at Panchgani. All the specimens were collected from an altitude of 4,100—4,400 feet. On going through the collection I find that it comprises eighteen species of snakes and five species of lizards. It appears that amongst snakes *Silybura brevis*, *Macropisthodon plumbicolor*, *Coluber helena* and *Naia naia* are fairly common at Panchgani. The collection holds a single specimen each of *Hemibungarus nigrescens* and *Echis carinata*. The commonest lizards to be found are *Calotes versicolor*, *Hemidactylus maculatus*, *Gymnodactylus deccanensis and Mabuia carinata* :—

Sub-order.—OPHIDIA

Family.—UROPELTIDAE

Genus.—*Silybura* Gray

Silybura macrolepis Peters. The Large-scaled Earth Snake.
Silybura brevis (Günther). Cuvier's Earth Snake.

Family.—COLUBRIDAE
Series.—AGLYPHA
Sub-family.—Colubrinæ

Genus.—*Nerodia* Baird and Girard

Nerodia (*Tropidonotus*) *piscator* (Schneider). The Chequered Keelback. ' Pániválá '.

Genus.—*Macropisthodon* Boulenger

Macropisthodon (*Tropidonotus*) *plumbicolor* (Cantor). The Green Keelback.

Genus.—*Lycodon* Boie

Lycodon aulicus (Linné). The Common Wolf Snake.
Lycodon travancoricus Boulenger. Beddome's Wolf Snake.

Genus.—*Ptyas* Fitzinger

Ptyas (*Zamenis*) *mucosus* (Linné). The Common Rat Snake or 'Dháman'.

Genus.—*Zamenis* Wagler

Zamenis fasciolatus (Shaw). The Fasciolated Rat Snake.

Genus.—*Coluber* Linné

Coluber helena (Daudin). The Trinket Snake.

Genus.—*Oligodon* Boie

Oligodon tæniolatus (Jerdon). The Variegated Kukri Snake.

Genus.—*Liopeltis*
Liopeltis (*Ablabes*) *calamaria* (Günther). Günther's Smooth Snake.
Series.—OPISTHOGLYPHA
Sub-family.—Acrochordinæ

Genus.—*Dipsadomorphus* Fitzinger
Dipsadomorphus ceylonensis Günther. Günther's Cat Snake.
Dipsadomorphus trigonatus (Schneider). The Common Cat Snake or Gamma Snake.

Genus.—*Dryophis* Dalman
Dryophis mycterizans (Linné.) The Common Green Whip Snake. 'Hirá or Hirvá Samp'.
Series.—PROTEROGLYPHA
Sub-family.—Elapinae

Genus.—*Bungarus* (Daudin)
Bungarus candidus (Linné). The Common Krait, 'Manar or Maniár'.
Sub-family.—Hydrophinae

Genus.—*Naia* Laurenti
Naia naia (*tripudians*) (Linné.) The Cobra. 'Nága'.

Genus.—*Hemibungarus* Peters
Hemibungarus nigrescens (Günther.) Günther's Coral Snake.
Family.—VIPERIDAE
Sub-family.—VIPERINAE

Genus.—*Echis* Merrem
Echis carinata (Schneider). The Saw-scaled Viper. 'Phoorsa'.
Sub-order.— LACERTILIA
Family.—GECKONIDAE

Genus.—Gymnodactylus Spix
Gymnodactylus deccanensis Günther.

Genus.—*Hemidactylus* Gray
Hemidactylus maculatus Dum. and Bibr.
Family.—AGAMIDAE

Genus.—*Calotes* Cuvier
Calotes versicolor Günther. The Common Bloodsucker. 'Sardá'.
Family.—VARANIDAE

Genus.—*Varanus* Merrem
Varanus bengalensis Boulenger. The Common Indian Monitor. 'Ghorpad'.
Family.—SCINCIDAE

Genus.—*Mabuia* Fitzinger
Mabuia carinata Boulenger. 'Sámpbámni'.

ST. XAVIER'S COLLEGE,
BOMBAY, *March 17, 1927.*

J. P. MULLAN.

XVIII.—PREYING HABITS OF THE TENT BUILDING SPIDER

I am unfortunately (or should I in view of the profundity of the articles on the subject in the Journal, say fortunately?) not what Mr. Pycraft would term an Etymologist, but I should be grateful if any reader of the Journal would enlighten me on the subject of a tragedy now taking place on the wall of this inspection bungalow over my office table—A small spider with a body about the diameter of one of my office pins is violently rushing in small circles round a small brown beetle-like insect with a body about as long as the head of a pin in width. The spider after about half a dozen revolutions clockwise, reverses its direction and puts in a spell anticlockwise. The beetle is obviously in difficulties and I conjecture that the spider is hobbling it by the winding an invisible thread round its legs.

The beetle is by now standing on its head with its body at right angles to the wall and bowing feebly; the spider is still revolving. What is the spider doing? is it merely tying up a capture in order to make a quiet dinner (it is now 7.30 p.m.) undisturbed by the dinner's struggles, or is it laying the beetle by for to-morrow's breakfast, or is the beetle to stay alive as food for the spider's progeny? I should be grateful for enlightment—as grateful as I am to the spider and the beetle for relieving an evening of undiluted office work.

CAMP MUKTI,
WEST KHANDESH,
January, 6, 1927.

H. F. KNIGHT, I.C.S.

[Commenting on the above Major R. W. G. Hingston writes as follows:—
The spiders Mr. Knight refers to belong to the family *Urocteidæ*. They construct silk tents in the angles of walls and are very common in India.

The tent consists of two layers and the spider lives between the layers. A delicate entanglement of threads is spread over the wall around the tent. The spider waits for prey within its tent. An insect happens to crawl near the tent, gets its feet caught in the surrounding entanglement. The spider then rushes out with lightning rapidity, whirls round and round the insect in one direction, all the time paying out a thread. Then it reverses and throws out another series of coils in the opposite direction. These circlings continue in alternating directions until the capture is completely enmeshed. The spider then takes the victim in its mandibles, injects a drop of poison, drags it into the tent, and sucks out its body juices.

The operation is therefore a kind of noosing or lassoing. The thread cast round the victim is very fine and can be seen only with a lens. So far as I have observed, ants are the usual prey of this spider. But small beetles will be captured if they happen to come that way.

I may add that Mr. Knight's observation is strictly exact. The habits, behaviour, etc., of this spider with a detailed account of its capturing operations have been described in a chapter entitled 'The Tent Building Spider' in my book *Nature at the Desert's Edge*. I do not know of any description of these habits published elsewhere. EDS.]

XIX.—SOME OBSERVATIONS ON THE COMMON INDIAN MILLIPEDE, *SPIROSTREPTUS* BRANDT

(*With a plate*)

The first stage in the study of Zoology in this country, when almost all the types studied were foreign, is now happily over. The types described in the Text-books, often not obtainable in this country, are being gradually replaced by animals which we find in our own neighbourhood; and with the help of pioneers like Dr. Prashad[1] and Dr. Bahl[2] we might expect a time not far remote when the Indian students' syllabus will be as free from all imported material as is necessary and desirable.

Study of life-history at first-hand, cannot fail to lend an additional interest to the anatomical details which so often prove dry and difficult to the beginners without it.

The Millipede that we are working on, with this object in view belongs to the phylum, Arthropoda, class Myriapoda, and sub class Progoneata.[3] It is fairly common in this part of the country, and is of a big enough size to be studied conveniently (about 4-6 inches long and 2 cm. broad). Its habits are interesting, and it can be kept in confinement under prolonged observation during which it may be induced to breed.

A large number of them were captured at the end of July and put in big glass jars containing a quantity of coarse saw-dust sprinkled with water. This

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[1] B. Prashad, Anatomy of the Common Indian Apple-snail (*Pila globosa*) *Memoirs of the Indian Museum,* Calcutta, vol. viii, No. 3, 1925.

[2] Bahl, K. N., *Pheretima posthuma, The Indian Zoological Memoir on Indian Animal Types,* Lucknow, 1926.

[3] Progoneata = Myriapoda in which the genital apertures are situated far forwards towards the anterior end of the body.

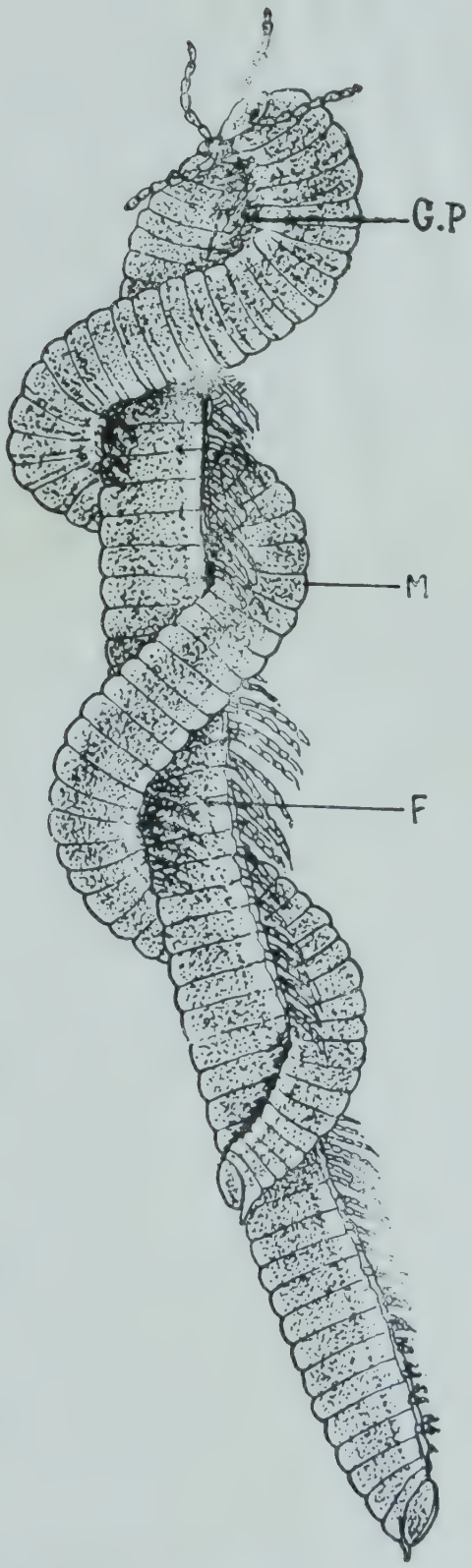


FIG. 3.—*Spirostreptus* in copulation.

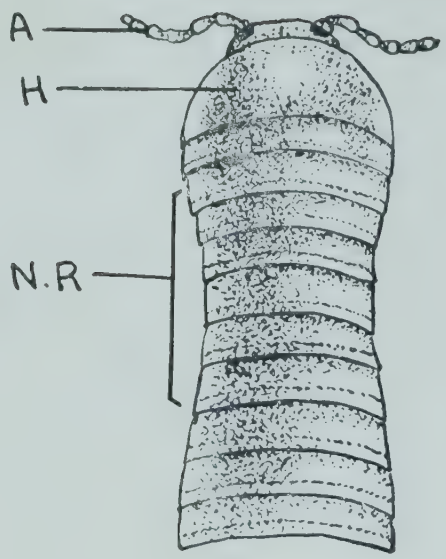


FIG. 1.—Anterior region of Female.

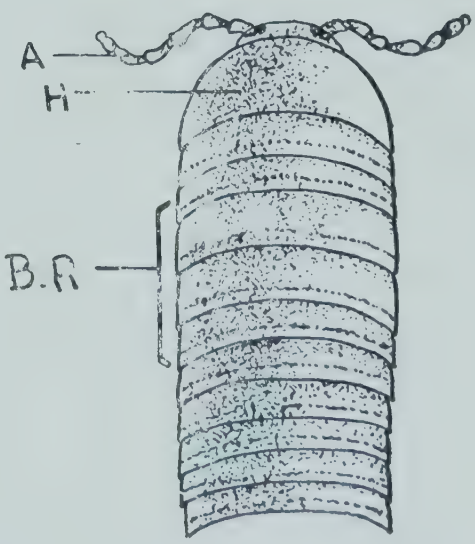


FIG. 2.—Anterior region of Male.

material is more suitable than ordinary soil because the animal can easily bore tunnels in it, and the moisture of this subtratum can be better regulated and varied according to need than is possible with garden soil, though no doubt, that is what the animal uses in nature. Further if a sufficient thickness of this material is used we get different layers from the bottom towards the top which vary in their water contens, and the animal has an option of selecting the right zone as to moisture and temperature—a point which is of vital interest to the captive animals during the winter season when their mortality is pretty high due to cold.

These millipedes are quite active, voracious feeders during the months of August, September, and October; but their activity and appetite suffer a remarkable diminution during November and December, when the atmospheric temperature is quite low.

They are purely vegetable feeders avoiding carrion when supplied as a test. They were tempted to eat of a piece of cake when hard pressed, but developed a kind of diarrhœa on the third day looking weak and depressed in spirit. They were again put on their usual vegetable diet and regained health quickly. Of the vegetables they seem to be partial to potatoes, both raw and boiled, pith of cabbage and *Trapa* (Singhara).

They avoid strong light, hiding themselves in their burrows, and come up to the surface for feeding late in the evening; they are quite busy eating and crawling at dusk.

The male and the female can be distinguished at a glance by looking at their anterior dorsal end. The head of the female is globular and the outline gracefully narrows behind the head for a short length before it assumes its former breadth (Fig. 1); whereas in the male there is no such narrowing at all—in its place we find two rings which are extra broad (Fig. 2). This is the best character to find the sex of the animal without handling it.

We found the animals in conjugating position very often in the months of September and October, and very young ones were also obtained from the fields at the same time.

Heathcote of Trinity College, Cambridge, collected a number of *Julus* in 1882 and observed them. He says that he is unable to find how long a time elapses after copulation before eggs are laid, but that he thinks it is short. Our observations are different according to which a pretty long time must elapse before eggs are laid. On referring to the literature that we have been able to consult we find no reference to the method of copulation, except Heathcote (1882) who says 'I have observed copulation which exactly takes place as described by Cuvier in his *Regne Animal* but on referring to the English translation of the book which we possess we could find no mention of it.

The copulatory posture might easily be mistaken for a life and death struggle between two opponents, so violent does it appear. The male suddenly bites the upper lip of the female between its own upper and lower lips; thus catching hold of the female it tightly coils round its body (Fig. 3). The genital apertures which are situated on the ventral side, a few segments behind the mouth, being apposed against each other.

In the writhing movements that follow the anterior third of the animals stand erect above the ground, the accessory copulatory organ of the male being firmly thrust into the female aperture. It lasts for about three to four minutes, and it is the male who takes the aggressive part.

Fabre (Ann. Sci. Nat. 1855) has described the breeding season to be September for captive animals. Sinclare has observed it to be May. We hope to be able to get eggs early next summer. If we are successful then it would appear that copulation takes place all the year round excepting the cold winter months. C. McCann of Xavier's College, Bombay, observed a nest of *Polydesmus* containing a single egg in the month of September; but as the egg contained an advanced embryo it must have been laid considerably earlier.

There is thus, it appears, no agreement between the habits of the few millipedes observed up to this time and it is therefore all the more necessary that the habits of this particular millipede should be known accurately.

The literature about the early development of millipedes is not too complete to be added to, and if they can successfully be made to lay eggs under observation, as we venture to hope, they would, under the conditions we have arranged—enough of fresh material would be in hand to push on with the subject.

Our best thanks are due to Dr. B. Prashad of the Indian Museum, Calcutta, for kindly identifying the Millipedes to be a *Spirostreptus*, and to Dr. K. N. Bahl, Professor of Zoology, Lucknow University, who suggested the work in hand.

M. L. BHATIA, M.SC.,
Lecturer in Zoology, Lucknow University.
and S. S. CHAUDHURY, M.A., M.SC.

LUCKNOW,
March 1927.

XX.—A PLAGUE OF GREEN BUGS (*NEZARA VIRIDULA*)

In July 1925 an extraordinary plague of the brown species of *Nezara viridula* (commonly known as the 'Green bug,' emitting a most disagreeable smell when touched) occurred in a shola above and bordering on my estate. Seething masses of the bug flew and crawled through the shola, covering the ground and the trees completely. They seemed to be feeding on nothing and were dying in millions and they were attacked I noticed by neither bird nor mammal! The smell was overpowering and disgusting. They moved out of the shola down into the estate and congregated on the branches of the shade trees, smashing all the branches of the Grevilleas by the sheer weight of their numbers. It had to be seen to be believed. When the survivors (still in their myriads) finally moved out of the estate they had left a lane a hundred yards wide, of shade trees with every branch and limb broken down and hanging.

HONNAMETTI ESTATE,
ATTIKAN P.O. *via* MYSORE,
April 5, 1927.

RANDOLPH C. MORRIS.

XXI.—THE USE OF PATENT BULLETS IN SHOT GUNS

In the Miscellaneous Notes of vol. xxxi, No. 4 of the Society's Journal, I read with interest the note on various patent bullets for use in smooth bore guns.

My own personal experience of them—and I have used them for a good many years—lies half way between the views of Mr. McCulloch and Col. Burton. Above fifty yards I do not think any of the patent bullets can be relied on for accurate shooting, but as regards their penetration I have a very high opinion indeed of them. My own experience only extends to the use of Lethal Ball and Rotax Bullets.

To give concrete examples I will just mention a few cases :—

A Sambhar at 40 yards. Lethal ball.—Bullet passed clean through the sambhar just behind shoulder.

A pig at 30 yards. Lethal ball.—Bullet passed obliquely through animal from near hind quarter to off foreleg. The pig was a large sized boar.

Two panthers at 20 yards. Rotax bullet.—In each case the bullet struck near the shoulder and passed far into the interior of the animal. One was a side shot and the other a frontal shot. In both cases the bullet smashed into little pieces inside, doing tremendous damage.

As a general rule the bullets penetrate but do not pass through, usually breaking up inside, but the above instances show what they are capable of. As regards the statement in Messrs. Rodda's catalogue, I have no doubt the statement is a copy of a letter received by them, but I am very sceptical as to the truth of the statement for the following reasons :—

It is fairly evident the tigers were shot from elephants in a drive. Now, it is very improbable that anybody would go for such a shoot armed with a smooth bore gun, as elephants usually imply considerable means or influence, and anybody in possession of either would also probably be in possession of a double H.V. rifle, which he would naturally use in preference to a smooth bore.

If we allow for the improbable, one might make a lucky shot at 110 or 135 yards or even 165 yards, because the penetration of these bullets is wonderful, but to make three such shots consecutively, and the last of them a galloping shot, is more than I can believe on the evidence available.

MAKRI, KONDAGAON P.O.,
BASTAR STATE, C.P.,
May 6, 1927.

W. H. O. SHORTT.

MEMORANDUM OF ASSOCIATION

Name

The name of the Society is the Bombay Natural History Society.

Objects

(*a*) To promote amongst the public the knowledge of Natural History in all its branches, including particularly the study of Animal and Plant Life of the Oriental Regions and the Zoo-Geographical Regions adjoining thereunto both alive and otherwise.

(*b*) To carry out researches in all branches of Natural History and to assist with information and advice as well as financially where possible, other institutions and individuals in similar pursuits.

(*c*) To provide, purchase, construct, equip, maintain and replenish a museum or museums or other repositories for animals or plants living or dead which are suitable for the study of Natural History.

(*d*) To carry on the business of Taxidermists and Preservers.

(*e*) To nominate and appoint members and to receive and recover contributions from them in aid of the objects of the Society.

(*f*) To engage and remunerate experts and other staff for any or all of the objects of the Society and to do and make all other acts, matters and things ancillary thereto or necessary and convenient for the purposes of the Society including the purchase or taking on lease of land and buildings.

(*g*) To do all or any of the aforesaid objects either solely or jointly with another or others and to enter into agreements for joint management, joint working, collaboration and any other arrangements with societies or persons having similar or allied objects which may further or benefit the objects of this Society.

We, the undersigned, hereby request that we may be formed into a society under the Societies Registration Act of 1860.

Note.—The signatories will be members of the Committee residing in Bombay. The names of the present Committee are entered here for information of members and these will form the first Committee of the Registered Society.

1927

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RULES AND REGULATIONS

THE MEMBERS

1. The Bombay Natural History Society (hereinafter referred to as 'the Society') shall consist of an unlimited number of members of either sex whose election shall be vested in a Committee constituted as provided in Rule 32 (hereinafter referred to as 'the Committee'). Persons who were members of the Society prior to its registration shall be deemed to remain members of the Society unless they shall otherwise determine and any life or other subscription paid by them shall for the purpose of regulating their position or status in the Society be deemed to have been paid to the Society.

There shall be three classes of members—Life Members, Ordinary Members and Honorary Members.

2. Every candidate for admission as a member other than an Honorary Member shall be proposed and recommended in writing by one or more members of the Society.

3. The Entrance Fee both for Life Members and Ordinary Members shall be Rs. 20, but the Committee may from time to time vary the same. No person shall be deemed to be a member until the entrance fee and subscription either as Life Member or Ordinary Member has been paid.

4. No dividend, gift, division or bonus shall be made by the Society unto or between any of its members in his or their capacity as member only, but any member occuping the position of a salaried official shall be entitled to receive remuneration from the Society for his services.

LIFE MEMBERS

5. *Life Members* are those members who have either on election or at some later date contributed to the funds of the Society in one sum a contribution of Rs. 350 or such other sum as may be fixed by the Committee from time to time.

6. Scientific Societies, Institutions, Libraries, Clubs, Officers' Messes and other such Co-operative bodies shall be admissible as members in their co-operative capacity, but shall not be admissible to life membership; such bodies may compound their annual subscription for a period of twenty-two years by payment to the funds of the Society of a sum of Rs. 350 or such other sum as may be fixed under clause 5 hereof.

7. The capital obtained from Life Membership contributions and compounded subscriptions shall not be used as revenue.

Ordinary Members

8. *Ordinary Members* are those persons who on election pay the entrance fee mentioned in Rule 3 hereof and the annual subscription.

9. If any person elected as a member shall omit to pay the entrance fee and annual subscription within six months from the date of his election, the Committee shall be at liberty to declare such election void.

10. The first annual subscription of members elected during the months of October, November and December in any year shall be considered to extend to December 31 of the following year. Any ordinary member subsequently becoming a life member may deduct from the amount of Rs. 350 the amount of the annual subscription paid by him for the then current year.

11. The admission fee and annual subscription of members resident outside India, or of members absent from India shall be the same as for members resident in India.

12. The payment of the entrance fee by a member shall be considered as an acceptance by such member of all the rules, regulations and bye-laws of the Society including the power to alter or vary the same.

13. The annual subscription of Rs. 25, or such other sum as may from time to time be fixed by the Committee, shall become due on the 1st of January in every year in advance. No member whose subscription is in arrear may exercise his privileges of membership; provided nevertheless that the Committee shall have authority to restore such defaulters on payment of all arrears.

14. When any member shall be in arrear in the payment of his annual subscription for two years he shall be advised by letter, addressed to his last known place of residence, that unless the amount due by him be paid within two months his name shall be removed from the list of members, and in the event of his failing to pay the amount within the period stipulated his name shall be removed from the roll of members. The Committee may however restore the name of any person so removed upon such terms as they may think fit.

15. Every member shall furnish in writing to the Honorary Secretary his address and any changes therein. The Society shall accept no responsibility for any loss or inconvenience that may arise through failure on the part of the member to carry out the provisions of this clause; nor shall it be necessary for the Honorary Secretary to issue any notice to members failing to do so.

Honorary Members

16. *Honorary Members* shall be eminent Zoologists or Botanists residing abroad who have rendered distinguished service to the Society and shall not exceed ten in number. Candidates for honorary membership shall be proposed by the Committee only and shall be elected by a majority of not less than three-fourths of the members of the Committee present and any person so appointed shall be denominated an Honorary Life Member and shall have all the privileges of a life member under the rules in that behalf.

Withdrawal and Removal of Members

17. Every member, having paid all fees due by him to the Society, shall be at liberty to resign therefrom upon giving notice in writing to the Honorary Secretary.

18. If any member shall have acted in a manner injurious to the good name of the Society or his membership shall have become undesirable so that it shall become expedient to remove his name from the list of members, the same shall be effected by a resolution of the Committee to be confirmed by a general meeting of the Society. The proposition shall be ballotted for and if eleven or more members vote and not less than two-thirds of the members so voting shall vote for such member's removal, he shall be removed from the Society accordingly.

Privileges of Members

19. Members have a right to be present and vote at all general meetings of the Society, to propose candidates for election to the Society and to have personal access for themselves or, at their request, their friends to such collections of the Society as are not open to the general public, to attend meetings of the members or functions of the Society and to introduce, either in person or by signed orders, visitors to any such meetings of the members or functions of the Society. Provided always that no friend or other person not being a member of the Society shall be entitled to be present at any general meeting of the Society convened for the transaction of the business of the Society.

20. Any member by making application (in writing if required) to the Honorary Secretary may have liberty of access to the Society's Library. Members may borrow for a stated period from the Society's Library such books as are not required for constant reference, with the proviso that a member shall be liable to replace any loss or make good any damage to books while in his keeping.

21. One copy of the Society's Journal shall be sent free to every honorary member and life member and also to every ordinary member whose subscription is not in arrears.

22. The services of the Society's Taxidermist Department for the treatment or setting up of Big Game Trophies, etc., are specially at the disposition of members subject to the exigencies of work required for the Museum. Members will be charged lower rates than will be chargeable to non-members.

23. Members shall have the right to purchase all publications of the Society at such price below the published price as may from time to time be fixed by the Committee.

The Annual General Meeting and the Election of the Committee, and of the General Management of the Affairs of the Society

24. A general meeting of members of the Society shall be held annually in the month of March or as soon after as may be convenient, on a day to be fixed by the Committee. The annual general

meeting shall be competent to receive and adopt the annual report and audited statement of accounts of the Society for the past year and to transact any other business which may be brought forward by the Chairman.

25. Notice of the time and place of the Annual General Meeting shall be advertised in two of the local newspapers and printed in two newspapers published outside Bombay at least fourteen days before the same shall take place.

26. The course of procedure at the Annual General Meeting after the chair has been taken, shall be as follows :—

(*a*) The reading of the annual report of the Committee.

(*b*) Presentation of the balance sheet and statement of accounts for the past year.

(*c*) The election of the Committee.

(*d*) Such other business as may be properly brought before the meeting.

27. No business shall be transacted at any general meeting of the Society unless a quorum be present when the meeting proceeds to business; six members personally present shall constitute a quorum. If within fifteen minutes from the time appointed for holding a meeting a quorum be not present, the meeting shall be adjourned to the same day in the following week, at the same time and place, and if at such adjourned meeting a quorum be not present within fifteen minutes from the time appointed for holding the meeting, the members present, whatever is the number, shall be competent to transact the business for which the meeting was convened.

28. Any question which may arise at any general meeting of the Society or at any meeting of the Committee shall be determined by vote, each member having one vote and the President or Chairman a casting vote in addition to his own vote.

29. The Committee may, whenever they think fit, convene an Extraordinary General Meeting and they shall on the requisition of at least ten of the members forthwith proceed to convene an Extraordinary General Meeting of the Society.

30. Any request so made by members shall express the objects of the meeting proposed to be called and shall be left at the office of the Society. Provided that such requisition may consist of several documents in like form each signed by one or more requisitionists. Upon the receipt of any such requisition the Committee shall forthwith convene an Extraordinary General Meeting and if they neglect to do so within one month from the date of delivery of such requisition at the office of the Society the requisitionists may themselves convene an Extraordinary General Meeting for the purpose specified and not for any other purpose, but no meeting so convened shall be held for three months from the date of the delivery of the requisition as aforesaid.

MANAGEMENT OF THE SOCIETY

31. The government and management of the Society shall be vested in a Committee consisting of the President, Vice-Presidents, Honorary Treasurer and Honorary Secretary, ex-officio and ten members resident in Bombay or within 200 miles of Bombay

exclusive of ex-officio members. This Committee shall be assisted in an advisory capacity by ten members chosen by the Committee from amongst members resident in the mofussil more than 200 miles from Bombay. All papers in connection with meetings of the Committee shall as far as possible be sent in advance to the Advisory Members of the Committee.

32. The Committee for the time being shall annually cause to be prepared a list of members whom they recommend to be elected as members of the Committee in the ensuing year. The names of the gentlemen so nominated shall be sent to all members along with the notice of the meeting and it shall be open to members, having obtained the previous consent of the nominee, to propose and second in writing within seven days of the date of the meeting the names of any members they desire to have elected. In the event of the number of members proposed for the Committee exceeding ten an election shall take place. The election shall be conducted as follows:—A list of the names proposed shall be sent to every Life Member and Ordinary Member resident in India who has paid his subscription for the year and the member shall place his initial against the names of those he wishes elected and return the same duly signed by him in a special envelope marked ' Voting Paper ' to the Honorary Secretary within three weeks of the issue of the same.

33. No voting papers shall be opened until three weeks after the date of the issue and they shall be opened by the Honorary Secretary in the presence of two members of the Committee and the result notified in writing to those elected and published in the next issue of the Society's Journal for the information of all members.

34. In the event of any vacancy on the Committee occurring during the course of the year the remaining members of the Committee may fill up such vacancy whether it be of an ex-officio member or ordinary member. Any member of the Committee absent from India for more than six months shall be deemed to have vacated his office.

35. The first Committee of the Society formed under the Societies Registration Act 21 of 1860 shall be the officers and Committee of the unregistered Society in office at the time of the registration of the Society whose names are set out in the list annexed to the Memorandum of Association.

The Duties of the Committee

36. The Committee shall meet at such times as shall be appointed by the President, or in his absence, by one of the Vice-Presidents, Honorary Secretary or Honorary Treasurer, due and sufficient notice being previously sent to every member.

37. At any meeting of the Committee four members shall form a quorum.

38. Seven days previous notice of any meeting of the Committee shall, as a rule, be given in writing by the Honorary Secretary to each member of the Committee and such notice shall specify the nature of the business to be transacted. Business of an urgent nature may be conducted by circular ; and in such case, it shall be

necessary in order to render valid any act of the Committee done upon a resolution by circular, that the circular shall have been seen by each member of the Committee present in Bombay, and that the majority of members shall have voted in favour of the resolution.

39. Should there be at any time no legally constituted Committee of the Society, or should the Committee at any time be unwilling to fill up vacancies occurring in the Committee during their tenure of office, the Honorary Secretary shall issue voting lists, either delivered by hand or sent through the post to each member of the Society in the same manner as prescribed under Rule 33.

40. The majority of votes shall decide every question brought before the Committee and in case of an equality of votes the Chairman of the meeting shall have a casting vote in addition to his own.

41. The President, Vice-Presidents or the Honorary Secretary upon the direction of the majority present at any meeting of the Committee at which not less than six members of the Committee are present, shall be competent to sign on behalf of the Society any contracts, deeds, pleadings, and any other documents relating to the affairs of the Society and not inconsistent in their terms with the purposes or objects of the Society, or with the rules and regulations.

42. A majority of the Committee present at any meeting at which not less than six members of the Committee are present may, at their discretion, and whenever they think fit, grant to an employee of the Society (whether employment be continued or not) in consideration of past services, or to the widow or any relation of a deceased employee, either a pension or a bonus, gratuity or compassionate allowance of such amount as the Committee may fix, and upon such terms as they may prescribe, to be paid out of the funds of the Society, and the Committee may also contribute out of the funds of the Society to a staff provident fund.

43. The Committee may appoint sub-committees for any purpose connected with the management of the affairs of the Society.

44. The Committee may from time to time frame Bye-laws for regulating the conduct and management of their business, or of the meetings or functions of any sub-committee appointed by them. But no such bye-laws shall be inconsistent with any of the purposes or objects of the Society or with its rules and regulations.

45. The Committee shall be competent to invite any salaried official of the Society to be present at their deliberations.

Patrons

46. One or more person or persons may be invited to accept the office of Patron of the Society at the discretion of the Committee.

47. Persons who have accepted the office of Patron of the Society prior to its registration shall be deemed to remain Patrons of the Society unless they shall otherwise determine.

Vice-Patrons

48. Any member of the Society who shall subscribe in his personal capacity a sum of not less than Rs. 5,000, to the funds of

the Society to be devoted to fostering any of the objects and purposes of the Society shall with the approval of the Committee be appointed a Vice-Patron of the Society.

49. A Vice-Patron shall hold office until death or resignation.

50. Persons who were Vice-Patrons of the Society prior to its registration shall be deemed to remain Vice-Patrons unless they shall otherwise determine.

Benefactors

51. Any member of the Society who shall in his personal capacity subscribe a sum of not less than Rs. 1,000 to the funds of the Society to be devoted to fostering any of the objects or purposes of the Society shall be termed a 'Benefactor' and shall become a life member if not already so.

The President and Vice-Presidents

52. The President shall preside at meetings of the Society or of the Committee and regulate all proceedings thereat and generally execute or see to the execution of the Rules and Regulations, Bye-laws and orders of the Society.

53. In the absence of the President from any meeting of the Society or of the Committee his place shall be filled by one of the Vice-Presidents, or by a member of the Committee then present, who shall for the time being have all the authority, privilege and powers of the President. If no member of the Committee be present at any ordinary general meeting, the members present shall nominate and appoint to be Chairman such member as they shall deem fit.

The Honorary Treasurer and the Accounts

54. The Honorary Treasurer or his deputy shall demand and receive for the use of the Society all monies due or payable to the Society and shall keep full and particular accounts of all sums so received. He shall also from time to time invest the funds of the Society as may be determined by the Committee. An account in the name of the Society shall be opened and all monies shall be deposited at the National Bank of India, Ltd., or such other Bankers as may be appointed by the Committee. No payment shall be made by the Honorary Treasurer without the signature of the Honorary Secretary. The Honorary Secretary may pass for payment by the Honorary Treasurer all the bills in connection with the Journal, salaries and petty expenses of the Society, without reference to the Committee, up to Rs. 1,000.

55. An account shall be opened in the books of the Society for every member of the Society stating the several sums payable by him, and time of payment of the same. The particulars also of all sums of money received and disbursed in the several departments of the Society shall be entered and the books and vouchers shall be open to the inspection of every member.

56. The financial year of the Society shall end on December 31, of each year and all accounts shall be made up to that

date and shall be audited by one or more auditors appointed by the Committee.

57. The auditor shall have the power of calling for a statement of liabilities and assets of the Society and for any information relative thereto.

58. The Honorary Treasurer shall make a report to the Society upon the day of the annual general meeting and present a balance sheet and statement of accounts for the past year which shall be printed in the Journal of the Society.

The Honorary Secretary

59. The Honorary Secretary shall conduct the correspondence of the Society.

60. The Honorary Secretary shall have supervision over all employees of the Society and shall generally see that the Rules and Regulations, Bye-laws and orders of the Committee are executed.

The Curator, Assistant Curators, Assistants, Clerks and Servants of the Society

61. The Curator, Assistant Curators, Assistants, Clerks and other servants of the Society with their respective salaries and duties shall be subject to the orders of the Committee and they shall not under any pretence whatsoever receive any perquisite or profit from their connection with the Society, except that which shall be expressly allowed by the Committee.

62. Every servant of the Society receiving or paying money on behalf of the Society shall be required before he enters upon the duties of his office to give security for the due execution thereof in such penalty and with such surety or sureties, as the Committee may deem expedient.

PROCEEDINGS

Proceedings of the Meeting held on June 28, 1927.

A meeting of the members of the Bombay Natural History Society and their friends took place on Tuesday, June 28, at 6.30 p m., at the Prince of Wales' Museum, Mr. H. A. W. Brent presiding.

The following forty-seven new members were elected since the last meeting :— Mr. D. F. Mursell, Moulmein, Burma ; Lt.-Col. F. P. Mackie, I.M.S., Bombay ; The Registrar, University of Madras, Madras ; Mr. M. Sharif, M.Sc., F.R.M.S., Calcutta ; Dr. Sunder Lal Hora, D.Sc., Calcutta ; Dr. H. Srinivasa Rao, M.A., D.Sc., Calcutta ; Dr. B. N. Chopra, D.Sc., Calcutta ; Mr. J. W. Borradaile, England ; Mr. C. T. Shaw-Mackenzie Lahore Cantonment ; Rao Bahadur Pundit Sir Sukhdeoprasad, B.A., Kt., C.I.E., Thakur of Jasnagar, Rajputana ; H. H. The Maharaja Shri Natwarsinghji Bhavasinghji, Maharaja Rana Sahib of Porbander, Kathiawar ; Lt.-Col. D. K. McLeod, Mardan ; Lt. Maharaja Purna Chandra Bhanji Deo, Ruling Chief of the Feudatory State of Mayurbhanj ; Mr. A. Todd, Bombay ; Mr. P. R. Duncan, I.F.E.S., Lucknow ; Maharaja Ramanuj Saran Singh Deo, C.B.E., Ruling Chief of Surguja State, Bilaspur ; Mrs. R. B. Robinson, Trichinopoly ; Sri Sri Sri Krishna Chandra Gajapathi Narayana Deo, Raja of Parlakimedi, Parlakimedi ; Major P. A. Opie, R.A.M.C., Poona ; Mr. R. G. Grieve, M.A., I.E.S., Ootacamund ; Mr. C. Ruxton Sharp, Bombay ; Le Directeur, Musee Royal d'Histoire Naturelle de Belgique, Bruxelles, Belgium ; Mr. J. B. Barclay, Bombay ; The University Professor of Zoology, University of Bengal, Calcutta ; Mr. J. R. Stockley Roper, R.A., Bombay ; Commander J. G. Bower, R.N., D.S.O., H.M.S. *Crocus*, Persian Gulf ; Mr. U. M. Mirchandani, Karwar ; The Director of Agriculture, Punjab, Lahore ; Mr. J. Ramsay Scott, Cawnpore ; The Mess President, 2nd Bombay Pioneers, Agra ; Mr. D. R. D. Wadia, Bar-at-Law, Bombay ; Miss P. M. Kanga, M.Sc., Bombay ; Raja Kishore Chandra Birabar Harichandan, Ruling Chief of the Feudatory State of Talcher, B. and O. ; Mr. C. Frank Riches, Eastern Duars ; Col. H. H. Nawab Sir Syed Mahommad Hamid Ali Khan Bahadur, Mutaid Jung, G.C.S.I., G.C.I.E., G.C.V.O., Nawab of Rampur State, Rampur ; The President, Mess Committee, The Rifle Brigade, Landikotal, N.W.F.P. ; The Librarian, University of Dacca, Ramna, Dacca ; Mr. Lalji Naranji, Bombay ; Major J. M. McKenzie, O.B.E., M.C., Bombay ; Capt. F. H. N. Davidson, D.S.O., M.C., R.A., Secunderabad ; Mr. R. G. Kilburne, Nepal ; Mr. Gerald A. Moore, Bombay ; Maharaja Jagadish Nath Ray of Dinajpur ; Mr. H. M. Mehta, Bombay ; Dr. Norman L. Corkill, M.B., C.H.B., Nisiriyah ; Mr. B. E. Maricar, Tavoy ; and Mrs. A. H. C. Captain, Bombay.

New Groups in the Museum

Sir Reginald Spence drew the attention of members to the new group cases which have recently been completed in the Museum. In the course of his lectures to the members of the Society and to other bodies on his return from his deputation to the United States and Europe, Mr. S. H. Prater, the Curator, had shown what great advances had been made in recent years by Museums in America and Europe in methods of Museum exhibition. Since his return, Mr. Prater and his staff have been occupied in preparing a number of new groups for the Natural History Section of the Prince of Wales' Museum, and visitors to the Museum will now be able to judge for themselves what great strides have been made in Museum technique and how science and art can be combined in the production of popular, educative and at the same time highly artistic exhibits. The Prince of Wales' Museum might congratulate itself on being the first institution of its kind to introduce these modern group cases into this country.

A Desert Scene

The first of these groups represents animal and plant life in the Indian desert region. Three years ago a case illustrating the same subject was placed on exhibition in the Mammal Gallery. The group had been constructed on methods that had been in vogue in museums for several years ; but a completely new technique has been employed in the construction of the new case. The scene is laid in the country near the Sind-Baluchistan Frontier. Through a window in the case the visitor looks upon a vast desert panorama of sand dunes and cactus and thorny scrub stretching to the distant horizon, where the limestone ridges of the Khirthar Range stand silhouetted against the glow of the setting sun. The vivid beauty of the desert sunset is effectively produced by concealed and filtered lights, which transfuse the sky with an orange light and cast a golden glow upon the sands. Faithful representations in wax of cactus and of the 'Ak' or Milk plant (*Calotropis*) lend reality to the scene. The animals introduced into the case are those typical of the Indian desert region and the naturalness of the setting graphically illustrates the harmony which exists between their colouration and their natural surroundings, thereby affording them an effective means of protection and concealment. An underground section on one side of the case introduces the visitor to the family life of the Desert Gerbilles which are seen in their burrow below a sand dune. Transparencies in glass set into the case depict various features of the desert landscape and illustrate the effect of scorching winds and shifting sands on the soil and its vegetation. The perspective has been cleverly maintained and an effect of limitless continuity has been given to the scene by the curved background of the group, which is one of the chief features of its construction. The painting of the background and the reproduction of the plant forms in wax are the work of Mr. K. B. Savardekar, whose painstaking and skilful work has contributed largely to the success of the reproduction.

Habits of Snakes

Three new groups illustrating the life-history and habits of snakes have been added to the Reptile Gallery. The *viviparous* snakes, or those which bring forth their young alive, are represented by the Russells Viper with its new-born brood of thirty-four young. The realism with which the mother with her lively brood of young are portrayed must be seen to be appreciated. The *oviparous* snakes are exemplified by the cobra, which is seen occupying a deserted ant-hill. The snake is seen coiled round its mass of eggs while an inset shows the development of the snake from the earliest stage to the time when it is ready to free itself from the egg chamber with the aid of its egg tooth. The third case illustrates how snakes poison their prey. The *Echis* or *Phoorsa*, perhaps the most vicious of our poisonous snakes, is shown in the process of swallowing its prey. A dissection showing the poison apparatus of the snake, enlarged models showing the types of fangs and a unique photograph showing a drop of poison emerging from the tip of a viper's fang completes the lesson which the case tends to teach. The plants, grasses and other accessories to these groups have been beautifully reproduced in wax and lend greatly to their attractiveness and interest.

House Flies And Disease

An acquisition to the Insect Gallery is the new case illustrating the house fly in its relation to the spread of disease—a timely exhibit during the monsoon season in Bombay. A very beautiful and accurate model of the House Fly was presented to the Society by Mr. F. V. Evans, one of its Vice-Patrons. The model shows the house fly enlarged twenty-eight times and reveals to the naked eye details of its structure which could otherwise only have been seen through a powerful lens. Enlarged models of egg, the larval and pupal stages of a fly have been introduced into the case, while a fly-ridden tray of sweetmeats shows, better than words can, one of the means by which the germs of disease are carried by flies to man.

The Museum and Schools

The educational activities of the Museum have not been concentrated entirely on its exhibition galleries, but considerable progress has been made during the past year in the teaching of Nature Studies to children in the schools. Nineteen local schools are now co-operating in the scheme. Two lectures have been

given daily in the Museum to pupils by Mr. Salim Ali, the Guide Lecturer, who has enthusiastically taken up this phase of the Museum's work. The lectures are illustrated with Museum specimens and by lantern slides. Considerable enthusiasm is being displayed by most of the classes, who as a rule show great eagerness to attend, one class coming all the way from Thana! Up to April 21, ninety-nine classes were held at the Museum attended by 3,115 pupils, and it is hoped by the end of this year that this number will be doubled unless the Education Department of Government are unable to find the funds to carry on the work started by the generosity of the late Sir Sassoon David, Kt., K.C.S.I., Bart.

Help for the Blind

An interesting phase of its schemes for interesting the public is the work the Natural History Section of the Museum has undertaken for the blind. By previous appointment with the Principal, forty boys from the Victoria Jubilee School for the Blind were brought to the Museum. They were given a talk on animal life and were given specimens to illustrate the lesson which they could themselves handle and feel. One little fellow after examining a tiger's skull and being told about the significance and utility of its teeth at once found out after passing his hand over a cat's skull that it was a flesh-eating animal and said probably this was a cat. The Museum is very keen on developing this work for the blind and the Curator hopes before long to prepare a series of exhibits which the blind will be able to handle and feel and which will be used for illustrating lectures for them.

Wild Elephants

Sir Reginald Spence later on read a very interesting paper on Wild Elephants in the United Provinces by Mr. F. W. Champion, I. F. S. The paper has since been published in full in the Society's Journal.

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1/9 Nat. size.

THE DEMOISELLE CRANE
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1/9 Nat. size.

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THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

PART V

(With a coloured plate)

(Continued from page 245 of this Volume)

SUB-ORDER BALEARICÆ

FAMILY BALEARICIDÆ

CRANES

The True Cranes are birds of large size with long necks and legs but with a bill only equal to, or but little longer than, the head. The nostril is enclosed by a membrane on the posterior side and it is placed in the base of a groove which extends about half-way up the upper mandible. There are 12 tail feathers and 11 primaries. The tracheæ pass into a hollow space between the long walls of the sternal keel and are more or less convoluted.

Our Indian Cranes were divided by Sharpe into the genera *Grus*, *Sarcogeranus*, *Antigone* and *Anthropoides*.. The name *Grus* is not tenable and has to give way to *Megalornis*, whilst the differences between this and *Sarcogeranus* seem hardly generic. On the other hand *Antigone*, not recognized by Blandford, is now generally accepted as sufficiently defined to form a good genus.

KEY TO GENERA

A. Crown of head bare; sides of head and upper neck feathered ... ... *Megalornis.*

B. Crown of head bare, sides of head and neck not feathered ... ... *Antigone.*

C. Crown of head feathered ... ... *Anthropoides.*

Genus—Anthropoides

Anthropoides.—Vieill., Analyse, p. 59, 1816.

Type.—*Ardea virgo* Linn.

In this genus the head is feathered throughout and there are long white plumes springing from behind the ear-coverts; the feathers of the lower neck are long and lanceolate, whilst the inner secondaries are much lengthened but not disintegrated as in *Grus*. The bill and legs are shorter in proportion than they are in that genus.

Anthropoides virgo

The Demoiselle Crane.

Ardea virgo Linn., Syst. Nat., 10th ed., i, p. 141 (1758). (*In oriente.* Restricted to India).

Anthropoides virgo. Blanf. and Oates, iv, p. 190.

Vernacular names.—*Karkarra* (Hind.); *Ghants* (Nepal); *Karkuchi* (Mahr.); *Kallam* (Deccan); *Gaara* (Uriya); *Wada-Koraka* (Tel.); *Kar-koncha* (Can.)

Description.—Forecrown to nape grey; patch below the eye, a line over the ear-coverts and long aigrette behind them pure white; remainder of head and neck black, the feathers of the lower fore-neck very long and lanceolate falling over the breast; winglet, greater coverts and wing quills blackish; ends of lengthened inner secondary plumes black, grading into the pale French grey of the rest of the plumage; the grey of the upper plumage extending on to the base of the hind neck.

Colours of soft parts.—Iris red-brown (possibly young birds) to crimson or red; bill sage-greenish with a red tip; legs and feet black.

Measurements.—Wing 450 to 530 m.; tail 165 to 182 m.; tarsus 170 to 187 m.; culmen 65 to 70 m.

Young birds are like the adult, but have the head wholly grey; the black of the neck is browner behind, more grey in front, and there are no lengthened plumes; wings coloured as in the adult but the inner secondaries but little lengthened.

Distribution.—Breeding in Southern Europe and the high plateaus of Algeria; Central and Northern Asia as far East as Western Mongolia. In Winter south to Northern Africa, Mesopotamia, Palestine and India. In the last-mentioned country it has occurred south as far as Kollegal in Coimbatore, but is rare south of the Deccan. East it extends through Eastern Bengal and Assam to the greater part of Burma, but it is not common east of Bihar.

Nidification.—No better description of the breeding of these beautiful cranes exists than that given by Dr. A. S. Cullen in his account of the Nesting of Birds in Bulgaria, though it is to be feared that the birds no longer exist in such great numbers.

> "This bird arrives in the Dobrudsha in about the second week of April. It makes its appearance in flocks of from twenty to thirty birds and upwards, and the form of these flocks very much resembles those of the Common Crane, and they almost always fly very high, especially when passing wooded country;

but when crossing the plains they fly lower, and occasionally come within gunshot. For the first week after their arrival flocks of these birds mingle with those of the Common Crane, and resort to any fields of newly-sown grain that they can find, and to these they often do great damage. Regularly once or twice during the day they repair to some lake or pond of fresh water to drink. In the evening the fields are deserted, all the birds going to the nearest lakes or marshes, where, I believe, they remain all night. About the second week after their arrival the flocks break up into pairs, which disperse themselves all over the country. Very soon after the birds have paired they begin to lay. Eggs may be found from about the third week in April to very nearly the end of May; but much depends on the state of the weather. The nest of the Demoiselle Crane is, without exception, made on the ground, usually amidst some kind of young grain, but often amongst grass on fallow land, and now and then, though more rarely, amongst stubble. The nest—if indeed such it can be called—is made by the birds pulling up or treading down the grain, grass, or stubble for the space of about two feet, and scratching the shallowest possible hollow in the middle of the bare patch thus formed. A few small straws and stones are often found in and about this hollow, but whether they are brought there by the birds, or found there by them, which is very probable, I cannot say with any certainty."

"I believe myself, however, that they are placed there by the birds. The eggs, which are never more nor less than two in number, are *always* placed side by side, in the hollow already described, with their small ends pointing in the same direction. The male assists the female in hatching the eggs; indeed, I have every reason to think that he sits as much as the female. To the uninitiated in the habits of this bird, its eggs are very difficult to find. When an intruder approaches the spot where the eggs lie, he at first sees nothing except perhaps a solitary bird standing on one leg as if sleeping. Should he not be a very good observer, as he draws nearer he will probably only notice a pair of birds walking rapidly away, plucking the grass as they go, apparently feeding eagerly, and he will most likely account for the sudden appearance of the second bird by concluding that it had been sitting on the ground resting, and will not think anything about the matter, and pass on. Very few persons indeed would at all suspect that the birds had a nest. Often, nay, almost always, when the birds have placed some distance between them and their nest, they will take flight, and to all appearance desert the spot altogether, but no sooner is the intruder's back turned, than there they are again in a wonderfully short space of time. One of the birds, I believe the male, always keeps watch over the other, except in the middle of the day in very hot weather, when the bird, which acts as sentinel, deserts its post and goes to the nearest pond or lake to drink. It does not, however, remain away very long."

"Should the bird whose place it is to watch while the other sits be absent, the sitting bird when disturbed is not quite so guarded in its movements, and will allow a much nearer approach. When the eggs are first laid the birds will leave them as soon as an intruder comes in sight, but as the incubation advances they become less shy, and will not leave their eggs so readily.

"I cannot say whether the bird which watches stands close to or a little distance from the nest. I rather incline to the latter opinion. If a crane be observed chasing other birds away from any particular spot, it is a sure sign that it has a nest not far off. This bird will give chase to eagles and great bustards without the least fear, should they venture near its nest. For all kinds of harriers and seagulls it has a great dislike. I have been told by the Tartars that, should a dog by chance go near the nest of this bird, both the birds will attack him, striking him with their beaks and wings, and making a great noise all the time. I myself have never had an opportunity of witnessing such an interesting encounter, but I am certain that this bird has sufficient courage for one. The Demoiselle crane is easily domesticated when young."

Dybowski says that in Dauria "it nests on the rocky banks of rivers and rarely on bare mountains. The nest is made of small stones fitting close to each other, the surface of the nest is flat or deepening somewhat towards the centre; it chooses sometimes a place which is a few inches higher than the surrounding ground, and fills up all the crevices and openings with stones."

The breeding season lasts from the middle of May to the middle of July, a month earlier in its most southern breeding haunts, even later in the more northern. The normal clutch of eggs is two only, but three are occasionally laid. In appearance generally they are small replicas of those of the Common Crane, but they are still longer and more narrow in proportion to their size. The ground colour varies from a pale olive yellow to a warm olive brown or olive green whilst the markings consists of large primary blotches of brown or purple brown and secondary blotches of neutral tint of pale purplish-lavender. In most eggs these are fairly numerous over the whole surface, but in some they are confined to the larger end where they form an indefinite ring or cap. One hundred and twenty eggs average 83·3 × 53·1 mm., maxima 91·4 × 55·1 and 84·2 × 56·6 mm.; minima 74·1 × 48·5 and 78·0 × 47·0 mm.

Habits.—The Demoiselle Crane arrives in India in October and the first flocks which arrive seem to fly straight down to their southern limits as it is said to arrive in the Deccan in the middle of October, whilst in the north few birds seem to settle until the end of that month, though they must pass over on their way south. They return North in March and April, Whistler recording numerous flocks from the Jhang District between March 8 and April 7. Both coming and going they assemble in vast multitudes, and a most interesting letter from Mr. A. A. Phillips, quoted by Whistler, gives a graphic account of one of these assemblies:

"On March 25, C. and I went out after them. They were a sight worth seeing and hearing. There seemed to be vast

divisions of them about, but we only *shikared* one division: while they were feeding on the ground there was a broad band of them for about 1½ miles. When alarmed they bunched together and looked just like a white pebble beach about 100 by 500 yards in extent, and when they rose the noise was like the roaring of the sea. We shot three which were all Demoiselles."

The dancing of this Crane is well known, Nordmann's description having been translated by Bree, as follows :—

"They arrive in the South of Russia about the beginning of March, in flocks of between two and three hundred individuals. Arrived at the end of their journey, the flock keeps together for some time ; and even when they have dispersed in couples, they reassemble every morning and evening, preferring in calm weather to exercise themselves together, and amuse themselves by dancing. For this purpose they choose a convenient place, generally the flat shore of a stream. There they place themselves in a line, or in many rows, and begin their games and extraordinary dances, which are not a little surprising to the spectator, and of which the account would be considered fabulous were it not attested by men worthy of belief. They dance and jump around each other, bowing in a burlesque manner, advancing their necks, raising the feathers of the neck-tufts, and half unfolding the wings. In the meantime another set are disputing in a race the prize for swiftness. Arrived at the winning-post they turn back, and walk slowly, and with gravity ; all the rest of the company saluting them with reiterated cries, inclinations of the head, and other demonstrations, which are reciprocated. After having done this for some time, they all rise in the air, where, slowly sailing, they describe circles, like the swan and other cranes. After some weeks these assemblies cease, and from that time they are constantly seen walking in loving pairs together."

In flight and voice these cranes are very similar to the Common Crane ; they migrate in broad ∨ shapes or in long waving lines, and their call is a beautiful sonorous trumpet, somewhat less loud perhaps than that of *Megalornis grus*. Vidal says that they are very slow rising off the ground, and considers the best way to get a shot at a flock is to walk straight up to it without concealment, "and immediately the first bird flaps his wings preparatory to taking flight, to run as fast as ever you can, straight at them. If you have any breath left in you, after a short spurt of 60 or 70 yards you are almost certain of a shot at the fag-end of the flock within killing distance."

Most people, however, who shoot cranes do so from behind the cover of a cart or of a led bullock, or if there be high crops about, by stalking them under cover of these. They are extremely wary, clever birds and, whether it is desired to shoot or trap them, they are very difficult to bring to bag. They are, however, sometimes caught in nets and, less often, in nooses, and when once caught soon become affectionate pets, but they are very jealous of other pets and jealous and irritable with small children.

As an article for the table the Demoiselle ranks very high, some people considering it the best of all Indian Game-Birds. They feed almost entirely on shoots, seeds and young crops, but also eat insects, small reptiles, etc.

Genus.—Megalornis

Megalornis.—Gray, List Gen. Birds, p. 85, 1841.
Type.—Ardea grus, Linn.

In the genus *Megalornis* the crown of the head is bare but the sides of the head and neck are feathered and not bare as in *Antigone*. The wings are long with the inner secondaries lengthened and considerably exceeding the primaries ; tail short ; the tibia naked on the lower half ; toes short and strong with short, blunt claws. The sexes are alike in plumage.

Cranes are almost cosmopolitan in range, three genera and five species being found in India.

Key to Species

A. Plumage grey, tail grey.
  (*a*) Throat grey ; white on neck confined to a line down the sides ... ... *M. grus.*
  (*b*) Throat white ; greater part of sides and back of neck white ... ... *M. monachus.*
B. Plumage grey, tail black ... ... *M. nigricollis.*
C. Plumage white ... ... *M. leucogeranus.*

Megalornis grus

Ardea grus Linn., Syst. Nat., 10th ed., 1, p. 153.
Type locality.—Sweden.

The typical form differs from our Indian bird in its darker plumage more especially in the colour of the inner ornamental secondaries.

Megalornis grus lilfordi

The Eastern Common Crane

Grus lilfordi Sharpe, Cat. B. M., xxiii, p. 252, 1894 (E. Siberia).
Grus communis. Blanf. and Oates, iv, p. 186.

Vernacular names.—Kurunch, Kurch (Hind.) ; *Kunj* (Sind) ; *Kullam* (Deccan) ; *Kulangi* (Tel.).

Description.—Lores and crown to nape bare black skin with scattered black hairs ; a broad band of bare skin brick-red to red, across the nape, the black hairs even more scarce than on the crown ; a patch of grey feathers behind the bare red spaces ; sides of face grey ; ear-coverts, sides of head and neck white running back behind the grey neck patch and down the hind neck ; winglet, primaries, the terminal portions of the primary coverts and the tips of the long secondaries black ; chin, throat and foreneck dark slaty brown ; remainder of plumage pale, almost silvery grey ; tail slightly darker grey, blackish towards the tip.

Colours of soft parts.—Iris orange-red to red-brown or crimson ; bill dull glaucous or dingy green, paler and more yellow towards

the tip; legs and feet black, the soles paler, more brown, greenish or even fleshy.

Measurements—Wing 533 to 608 mm.; tail 192 to 205 mm.; tarsus 225 to 258 mm.; culmen 103 to 118 mm.

Young birds have the edges of the grey feathers isabelline or rufescent isabelline; the sides of the head and neck and hind neck pale rusty rufous; feathers cover the red bare skin on the nape whilst the crown also is more or less covered with the same; the drooping inner secondaries are wanting.

Half-grown birds have the edging to the feathers more rufous and more conspicuous and the whole crown and neck clothed with rusty coloured feathers.

Chicks in down are pale golden fulvous above: a broad line of deeper tint runs down the centre of the back and two narrower, less defined lines from the wings down each side of the body; centre of crown and a mark above the eye dark golden rufous; below sandy buff, albescent on the chin and foreneck and pale on the centre of the abdomen.

Distribution.—The Eastern Common Crane breeds in Eastern Siberia from the Yenesi basin eastwards and in Turkestan. In winter south to China and practically the whole of Northern India. It is extremely common in North-west India and extends south through the greater part of the Bombay Presidency and the Deccan. It has occurred in Southern Orissa and I have seen it as far East as Lakhimpur and Cachar in Assam on several occasions.

Nidification.—There is very little that I can find on record in regard to the breeding of the Eastern form of the Common Crane H. E. Dresser had eggs which he received from the Russian collectors round about Tomsk which is considerably to the West of the Yenesi. Of these he merely says that they differ in no way from the European bird and that their breeding habits are similar. I have also two pairs of eggs in my collection collected by Smirnoff north of the town of Yenesi and on the east of that river. A brief note which accompanies the eggs says: "These birds breed in small communities of half a dozen or so, the nests being placed on the ground from 50 yards to half a mile apart, sometimes two quite close together. The nest is a big untidy one made of all kinds of things which the birds pick up from the ground such as rushes, moss and lichen and other scraps. It is sometimes quite high, as much as a foot whilst across it sometimes measures over a metre. The eggs always number 2."

The sort of country it selects as a breeding site is nearly always such as contains swamps and lakes and it is said by Burturlin to sometimes breed on the extreme edge of the lakes in among the rushes and reeds, probably however, more often it breeds on marshy ground some little distance from the lakes themselves.

The only eggs I have seen of this race have all been laid in May or early June but they are said to breed sometimes as late as the last week of the latter month. The eggs could not possibly be distinguished from those of the Common European Crane. In shape they are rather long drawn-out ovals, the smaller end blunted although distinctly smaller than the other end. The texture is

rather coarse but the surface is quite smooth though with little, if any, gloss and the shell is stout though not particularly so for such large eggs. The ground colour varies from a pale greenish-grey or yellowish-grey to olive or yellow brown and the whole surface is sparingly marked with reddish-brown streaks and blotches with other secondary markings of paler tints of the same and dull lavender grey. Occasionally an egg is found with rather darker browner markings.

Six eggs average 93·8 × 59·6 m., maxima, 95·2 × 95·0 m.; minima 90·2 × 57·0 m.

Burturlin gives the breeding distribution of the eastern form of the Common Crane as Altai, Turkistan, Dauria to Manchuria and north from Siberia to the 66th degree of latitude.

Habits.—In India, the Common Crane is only known to us as a winter migrant, arriving generally about the second or third week in October; Hume records their arrival on one occasion as early as October 3, whilst Doig says that in Sind, many birds arrive as early as the end of August, though this must be very exceptional. They begin to leave again by the middle of March, the bulk of the birds moving about the end of that month and a few staying on until the end of April. These late birds Hume thought were young birds not anxious to breed and therefore not leaving as early as the old ones. In the east of India the few Cranes that are to be seen arrive in November and I do not think that I have ever seen them after the second week in March. In North-west India they are often found in very great numbers said sometimes to be in many hundreds.

The Crane is undoubtedly one of our most wary game birds and one of the most difficult to approach within gun shot.

Colonel Tickell refers to this bird and gives a most interesting account of their habits which is quoted by Blyth in his monograph on the Cranes. He says:—

> "In serene weather in the cold season, when, though the skys are cloudless blue, the mild atmosphere enables the sportsman to roam all day long over miles of far-reaching plains, the sonorous trumpet call of the Crane is one of the most familiar sounds that meet the ear. The cry resembles the syllable 'kurrk' a single loud brassy note, harsh and metallic, but mellowed by the vast distance at which it is generally heard. At such times the birds may be seen high in the air, advancing in an angle or in a single diagonal line winnowing their way across the pathless vault to distant regions, or soaring round and round in irregular swarms, and independently, as if reconnoitring the country below to select a fit place for their nocturnal meal. When thus employed sometimes two or more parties meet, and the clamour amongst them then becomes extreme, like the mutual clacking and cackling of assembled geese. Should the country, as beforesaid, be quite open, and no human being be observed moving on the plain, they will sometimes descend to the ground in the day-time, and on such occasions the downward sweep, from a height of perhaps a mile in the air to the face of the earth, of two or

three hundreds of these large birds, is a majestic spectacle, though of necessity only to be seen from afar."

"I once, indeed, met with a striking exception to this wary habit of the Crane in keeping, during the day, out of gunshot in the air. In January, 1845, as I was one day riding along the Trunk road (as the old Government road from Calcutta to Delhi is called), in the district of Manbhoom, near the village or Chowkee of Niamutpoor, I came in sight and within point blank ball shot of a host of these birds collected in a rice stubble field. There was a prodigious concourse of them amounting probably to a thousand. They were making a deafening clamour and seemed in great agitation, while every now and then a party of them would take wing and fly off, generally to the eastward, towards the Damoodur River, but many went in other directions. The country in the vicinity was open and wild, with bushes scattered about, and here and there a cultivated patch; the hour early in the morning, by sunrise they had all disappeared. I was told by the villagers that as night fell the birds would return and re-assemble in the same spot, and that they had been in the habit of doing so for many years. I confess I was never more astonished at anything within the circle of Ornithology than at this instance of exception to the wild and wary habits of the Crane. They could not have assembled in the field (which was not a large one) to feed, as the grain in the stubble would not have afforded a night's meal to a tenth part of the flock. The most probable conjecture is that they fed elsewhere during the night, as is the wont of the bird and repaired to that particular spot to rest till dawn, congregating in separate and independent parties. But why they should have collected night after night and have stopped so near a village, and so liable to approach, is inconceivable. The people of the vicinity are, it must be noted, no shikaries and the report of a gun was probably a sound almost unknown in that part of the district. The Crane, like most waterfowl, feeds at night, more as a matter of precaution than by choice. No such nocturnal habits are perceived in tame individuals, nor, is it probable, in the wild steppes of Tibet or Siberia, where these birds breed unmolested and roam about free from the sight even of a human being."

"In India, after filling their crops with the gleanings from the rice and vetch stubbles, the Cranes retire at or soon after sunrise to sand flats or islets in large rivers, or to open downs inland, where no coverts afford means of approach to an enemy. And there they may be seen through a telescope, preening themselves, lazily stretching forth their legs or wings, or sitting dozing on their heels. One or two, however, keep on the alert, their heads raised high; and these, to judge by their size and flowing plumes, are old males."

As we have already seen the Crane is a magnificent flier, one with great power and endurance and also capable of carrying out both graceful and intricate evolutions at pleasure. It is also a fine

runner and a wounded bird will often give its would-be captors a long chase before success crowns their efforts, indeed on marshy ground a second shot is generally necessary to bring to bag a bird that is merely winged. He is also a good swimmer but takes to water of swimming depth only under pressure, though they are very fond of wading about in shallow water when there is a supply of food to tempt them. The Common Crane, like all cranes, when only wounded, will put up a very fierce resistance to capture, striking viciously with the bill but, as Hume points out, a very slight tap with a stick on its long slender neck is quite sufficient to place it *hors de combat*. Hume gives a remarkable example of the force with which a Crane shot dead falls to the ground He writes: "As we walked back to the boat we became aware that an enormous flock of Cranes that had been trumpeting all the while, were practically over our heads. I wanted to unload my big gun and so fired at random straight up. I had hardly recovered from the recoil when a peculiar rushing sound caught my ear (luckily the sound outsped the bird), I just started back to listen when with a 'scrush' a dead bird plopped on the ground at my feet. The Crane had fallen back downwards, the shoulders first striking the ground and was firmly embedded in the clay. We pulled it out and found a basin-like depression in the ground, as far as I could judge in the dark, fully 8 inches deep in the deepest part."

Cranes feeding as they do so much in cultivation, very soon get used to the cultivators moving about in their small carts or with their bullocks and frequently do not trouble to keep out of gun-shot of these familiar objects. Accordingly, advantage is taken of this both by Indian and European sportsmen who approach under cover of bullock cart or bullock and thus get shots at birds which it would be otherwise impossible to approach. At other times birds may be driven towards the sportsmen but to do this with any success a few beaters only must be employed and these must know their work well. For a line of beaters to walk straight towards the birds is merely a signal for the latter to rise *en masse* and to take their departure high in the air and far out of shot of the gunners. If the birds are to be persuaded to fly over these latter within shot, the two or three beaters employed must slowly and apparently casually work their way up towards the birds so that these do not become really frightened, but gradually move along in the desired direction until finally they are within about 100 yards of where the sportsmen are hiding, when they may be startled into flight. A flock, however, once thus moved and shot at may be given up as hopeless for the rest of the day and if more birds are wanted, the sportsmen must move on to fresh ground.

Cranes are very omnivorous in their diet but probably on the whole prefer a vegetarian meal to any other. Different shoots of all kinds of crops, especially rice, are greedily eaten and in some cases, when the flocks are numerous and large, they cause considerable damage to crops. They are said to be especially fond of water melons and destroy even more of these than they eat. In

addition to all kinds of aquatic plants, grain and shoots they will eat any small reptile and all kinds of large insects and it has been alleged that on occasions they even catch fish. They feed principally in the very early mornings and late evenings whilst, where they are much disturbed, they feed a great deal during the night, more especially when there is a moon. During the hot hours of the day they resort to the banks of rivers and tanks where they have a wide view all round them and there pass the time away dozing and often standing on one leg in shallow water with their head and neck tucked away into the feathers of the back. Directly they flight towards their feeding grounds Cranes become very noisy, constantly uttering a loud trumpet-like call but during the day they seem to keep more or less silent.

Like all their family this bird indulges in dancing during the breeding season and at odd moments even during the Winter months, when the attitudes, bowings and scrapings indulged in during these preformances are often very ludicrous.

A flight of these birds when moving for any distance is always carried out in regular formation, either a long line or a wide 'V', the leader at the apex apparently changing place every few minutes with one of the other birds in the rear. When flying short distances from one feeding ground to another, this formation is not always observed and the birds move in indiscriminate flock.

(*To be continued*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., PH.D., F.L.S.

PART V

GRAMINEÆ

BY

E. BLATTER and C. MCCANN

(*Continued from page 298 of this Volume.*)

27. CLEISTACHNE, Benth. in Hook. Ic. Pl. xiv, 60, t. 1379 ; Stapf in Fl. Trop. Afr. ix, 154.

Tall, rather coarse grasses, annual according to Stapf, perennial according to Hook. f. Leaves long, narrow, flat, with stout midribs. Panicles narrow, more or less contracted, greyish or fulvously hairy. Spikelets solitary, all alike, hermaphrodite, pedicelled on the tough rhachis of racemosely arranged or panicled racemes, falling entire from the thickened tips of the pedicels. Florets 2, lower reduced to an empty glume, upper hermaphrodite. Involucral glumes equal, very similar, with involute margins, more or less coriaceous, delicately 7–9-nerved, muticous. Floral glumes hyaline, lower 2-nerved, upper 2-dentate or subentire, 3-nerved, with a twisted flexuous awn from the sinus or tip ; pale very minute, ciliate. Lodicules 2, broad-cuneate, sparingly ciliate. Stamens 3. Stigmas laterally exserted, plumose. Grain oblong to obovoid-oblong, very obtuse or truncate ; embryo half the length of the grain.

Species 3, one in West India and 2 in tropical Africa.

1. **Cleistachne Stocksii**, Hook. f. in F. B. I. vii, 163.

Description : Stem tall, stout, simple. Leaves 30–40 cm. by 12 mm., finely acuminate, softly hairy, midrib stout, margins slightly thickened, ciliolate, sheath terete, ligule oblong, coriaceous. Panicle 15–20 cm. long, long-peduncled, sub-erect ; rhachis and branches sparsely ciliate, pedicles of spikelets strigose with bright yellow hairs. Spikelets 5 mm. long, crowded, dark brown, callus short, bearded. Lower involucral glume dark brown, obscurely many-nerved, hirsute, shining, upper like lower, but narrower nearly glabrous. Lower floral glume 2-nerved, margins infolded, tip hispid, upper a twisted awn 16–25 mm. long, dilated at the base into a hyaline, entire, 3-nerved membrane, embracing the minute, ovate, obtuse pale.

Locality : Tungar forest, Bassein (Bhide !).

Distribution : So far only found in Malabar on the Bababoodan Hills.

28. VETIVERIA, Thouars ex Virey in Journ. de Pharm. 1. ser., xiii, 499 ; Stapf in Fl. Trop. Afr. ix, 156.

Coarse, perennial, glabrous grasses ; rhizomes stout ; culms stout, more or less compressed below. Leaf-blades firm to hard, conduplicate in bud, then flattening out, at least upwards, gradually passing into the sheath ; lower sheaths much compressed, flabellate-imbricate. Panicles erect, long, of many-rayed whorls of slender simple or rarely compound racemes, glabrous except for the frequently bearded calli. Spikelets 2-nate, of each pair subsimilar, differing in sex, one sessile, the other pedicelled, on the articulate fragile rhachis of copiously whorled (rarely panicled) peduncled 3-to many-jointed racemes, the sessile spikelets falling with the contiguous joint and the accompanying pedicelled spikelet or at least the accompanying pedicel ; joints and pedicels slender, slightly and gradually thickened upwards. Florets 2, lower reduced to an empty glume, upper hermaphrodite in the sessile, male in the pedicelled spikelets. Sessile spikelet laterally slightly compressed, awned or

awnless. Involucral glumes equal, lower more or less coriaceous or chartaceous with a broad rounded back and subinflexed margins, usually muticous, upper boat-shaped, keeled upwards, with broad hyaline ciliate margins, muticous, mucronate or aristulate. Floral glumes hyaline, of lower floret 2-nerved, of upper minutely 2-dentate, muticous or mucronulate or with a perfect or imperfect awn from the sinus. Pale minute, hyaline, nerveless. Lodicules 2 glabrous. Stamens 3. Stigmas laterally exserted ; styles subterminal. Grain oblong, slightly oblique at top. Pedicelled spikelet dorsally compressed ; involucral glumes much thinner than in the sessile, like the floral glumes usually awnless.

Species about 7 in the tropics of the Old World.

1. Leaves 5–13 cm. long. Panicle 15-18 cm. long ... 1. *V. Lawsoni.*
2. Leaves 30–90 cm. long, Panicle up to over 30 cm. long ... ... 2. *V. zizanioides.*

1. **Vetiveria Lawsoni**, Blatter & McCann, *nov. comb.*—*Andropogon Lawsoni*, Hook. f. F.B.I. vii, 187.

Description : Rootstock stout, horizontal. Stem erect, simple, slender, internodes very long. Leaves chiefly subradical, 5–13 cm. by 5 mm., exactly linear, rigid, curved, acute or obtuse, tips serrulate, base not contracted, margins ciliate, nerves 4–8, strong ; sheaths compressed, of lower very short, of cauline very long, striate ; ligule a ridge of hairs. Panicle 15–18 cm. long, narrow, elongate, branches or peduncles of spikes opposite and fascicled, branchlets slender, puberulous with a white scurf. Spikes 6–12 mm. long, pale reddish, erect ; joints 6-8, very obliquely truncate, tips obscurely ciliate, pedicels nearly equalling the spikelet, slender, compressed. Sessile spikelets 4 mm. long, linear-lanceolate, callus bearded with silky hairs. Lower involucral glume linear, rigid, coriaceous, tip obtuse, bristly, keels muricate, scaberulous margins inflexed, upper involucral glume cymbiform, tip 2-fid, awn longer than the glume, base ciliate, keel pectinately ciliate above the middle. Lower floral glume oblong, ciliate, nerveless, upper arched, linear, obtusely 2-dentate, awn very slender. Pale oblong, ciliate, nerveless. Anthers long. Pedicelled spikelets male, longer and narrower than the sessile, callus naked ; lower involucral glume 3-nerved, awned, keels pectinately ciliate, upper acuminate, awned. Floral glumes oblong, obtuse, ciliate.

Locality : S. M. Country : Dharwar District, very common (Sedgwick 2170 !) ; Dharwar (McCann A277 !).

2. **Vetiveria zizanioides**, Stapf in Kew Bull. (1906), 346-49, 362, in Fl. Trop. Afr. ix, 157.—*V. odorata*, Virey in Journ. de Pharm. 1. ser. xiii, 499.—*V. arundinacea et muricata*, Griseb., Fl. Brit., W. Ind. 559, 560.— *Phalaris zizanioides*, Linn. Mant. Alt., 183.—*Andropogon muricatus*, Retz., Obs. iii, 43 ; Roxb. Fl. Ind. i, 265 ; Grah. Cat. Bomb. Pl. 238 ; Griff. Ic. Pl. As. t. 139, f. 57, t. 155, f. 1 ; Dalz. and Gibs. Bomb. Fl. 302 ; Duthie Grass. N. W. Ind. 90, Fodd. Grass. N. Ind. 36, t. 24.—*A. Festucoides*, J. S. Presl in C. B. Presl Reliq. Haenk. i, 340.—*A. squarrosus*, Hack. (*non* Linn. f.) var. *genuinus*, Hack. in Monogr. Androp. 542-44.—*A. squarrosus*, Hook. f. (*non* Linn. f.) in F. B. I. vii, 186.—*A. squarrosus*, Cooke (*non* Linn. f.) in Fl. Bomb. Pres. ii, 991.—*Agrostis verticillata*, Lam. Ill. Gen. i, 162.—*Anatherum muricatum*, Beauv. Agrost. Expl. Planch. 15.

J. D. Hooker and Cooke and many others have followed Hackel in calling this plant *Andropogon squarrosus*, Linn. f. Stapf (in Kew Bull. 1906, 347) has explained that this name applies to quite a different plant : 'No notice was taken of Scheuchzer's description or of Petiver's and Du Bois's specimens, and when Linnæus, about 1770,[1] received the grass from Koenig he described it as something new under the name *Phalaris zizanioides*. Koenig, however, also sent specimens of the grass to Retzius, who published it as *Andropogon muricatus*[2] in 1783. This name, which was suggested by Koenig himself, was subsequently adopted by Roxburgh and most other botanists. More recently,[3] however, it has been replaced by *Andropogon squarrosus*, a name adopted by the younger Linnæus[4] for a plant, also communicated by Koenig, who found it

[1] Linnæus, Mant. Alt. (1771), 183.
[2] Retz. Observ. iii (1783), 43.
[3] Hackel, Andropog. in DC. Monogr. Phaner. vi (1889), 542.
[4] Linn. f. Suppl. (1781), 433.

" circa Zeylonam natans supra stagna profundiora," and entirely distinct from *Andropogon muricatus*. The specimen is still in Linnæus' herbarium and was correctly identified by R. Brown[1] with his *Panicum abortivum*, that is *Chamæ raphis spinescens*, a characteristic floating grass of the Indo-Malayan region. Retzius[2] himself is responsible for the erroneous reduction of *Andropogon squarrosus* to *Andropogon muricatus*, which recently has been revived, although Roxburgh[3] long ago drew attention to the confusion. "*Zizanioides*" being the earliest specific epithet, it will have to be adopted for the " Khas Khas," so that its name under *Veliveria* must be *V. zizanioides*.'

Vern. Names : Vala, Ushir, Valo, Bala, Khas Khas of the Anglo-Indians.

Description : A densely tufted perennial grass. Rootstock branching with spongy aromatic roots. Culms stout, up to over 1·8 m. high, usually sheathed all along. Leaf-sheaths compressed, especially the lower which are sharply keeled and fan-like, imbricate, very smooth, firm ; ligules reduced to a scarious rim ; blades narrowly linear, acute, 30–90 cm. long, 4·2–10·6 mm. wide, erect, rigid, firm or somewhat spongy, usually glabrous, rarely more or less hairy downwards on the face, pale green, midrib slender, lateral nerves close, 6 or more on each side, rather stout, slightly prominent, margin spinously rough. Panicle oblong, up to over 30 cm. long, usually contracted ; rhachis stout, smooth ; whorls 6–10 with up to 20 rays ; branches oblique to suberect, naked for up to 5 cm., filiform, slightly rough. Racemes up to 5 (rarely 7·5) cm. long, very slender ; joints about as long as the sessile spikelets or sometimes distinctly exceeding them, smooth or more or less rough, minutely and unequally ciliolate at the slightly oblique tips ; pedicels similar, but shorter. Sessile spikelet linear-lanceolate to almost linear, acute or subacute, 4·2–4·8 mm. long, yellowish, olive or violet-brown or purplish to almost black ; callus obtuse, under 1 mm. long, glabrous. Involucral glumes, acute, coriaceous, lower muriculate all over the back, 5-nerved, lateral nerves close, very fine ; upper spinulously muricate on the keel. Lower floral glume as long as the involucral glumes, acute, reversedly ciliolate, upper up to 3·3 mm. long, narrow, oblong-lanceolate, mucronulate, ciliate. Lodicules 2, quadrate and conspicuous, though small. Styles and stigmas short. Stigmas purple. Anthers 2–3·3 mm. long. Pedicelled spikelet sparingly aculeolate or almost smooth ; upper floral glume entire, acute.

Locality : Gujarat : Road to Lasandra (Chibber !) ; Daman (Bhide !) ; Ahmedabad, common in damp valleys (Sedgwick !).—*Konkan* : Ghatkoper, Horse-shoe Valley (McCann 9957 !).—*N. Kanara* : Dandeli (Talbot 2209 !).

Cke. l.c. classes this species amongst non-indigenous plants. We are of opinion that it is indigenous in most parts of the Presidency.

Distribution : Practically over the whole of India, and eastwards to Burma. Occasionally cultivated. Lower Guinea in Tropical Africa. Throughout the Malayan region only cultivated or as an escape. Introduced into the Mascarenes, the West Indies and Brazil.

Early history and economic uses : See Stapf in Kew Bull., l.c.

29. CHRYSOPOGON, Trin. Fund. Agrost. 187 ; Stapf in Fl. Trop. Afr., ix, 159.

Perennial (at least in the Old World). Leaf-blades narrow. Panicles usually lax, of whorls of simple or basally divided filiform branches, rarely the branches 2-nate or solitary. Spikelets in threes at the ends of the branchlets of terminal panicles, one sessile, the other 2 pedicelled, the three falling entire from the thickened, nearly always bearded, oblique tips of the peduncles ; exceptionally 2-nate in 2-jointed racemes, one sessile, the other pedicelled, each sessile spikelet falling with the contiguous joint and its pedicelled companion, pedicels and joints, if present linear-filiform, never longitudinally grooved or appendaged. Florets 2, lower reduced to an empty glume, upper hermaphrodite in the sessile, male or neuter in the pedicelled spikelet. Sessile spikelets usually laterally compressed, awned. Involucral glumes subequal ; lower coriaceous or chartaceous, involute with a rounded

[1]R. Brown Prodr. Fl. Nov. Holl. (1810), 193.
[2]Retz., l. c., v (1789), 21.
[3]Roxburgh Fl. Ind. ed., Carey and Wall. I (1820), 270.

back or complicate and more or less keeled upwards, upper boat-shaped, more or less keeled. Floral glumes hyaline, lower 2-nerved, upper linear, entire or 2-dentate with a usually perfect awn from the sinus. Pale 0 or small, hyaline, nerveless. Lodicules 2, small, glabrous. Stamens 3. Stigmas exserted laterally low down. Grain linear, laterally compressed ; embryo half the length of the grain ; scutellum linear-oblong. Pedicelled spikelet dorsally compressed, awnless or aristulate.

Species about 18 in the hot parts of the Old World, only a few entering the temperate zone. One in Florida and Cuba.

Cooke (ii, 984–986) describes 4 species of *Andropogon* belonging to the section *Chrysopogon* : *A. aciculatus*, Retz., *A. lancearius*, Hook. f., *A. monticola*, Schult., and *A. Aucheri*, Boiss.

To these we add 4 species not noted from the Presidency before : *Chrysopogon Wightianus*, Ness, *Ch. asper*, Heyne, *Ch. polyphyllus*, Blatter and McCann, and *Ch. Gryllus*, Trin.

A. Pedicels of the upper spikelets half as long as the sessile spikelets or longer	
I. Pedicels of upper spikelets glabrous or nearly so	
1. Stems erect. Leaves 15–45 cm. long ...	1. *C. Gryllus.*
2. Stems creeping below. Leaves 2–13 cm. long	2. *C. aciculatus.*
II. Pedicels of upper spikelets villous with rusty rarely pale hairs	
1. Lower involucral glume of pedicelled spikelets long-awned, upper not or very shortly awned	
(*a*) Callus long villous all round ...	3. *C. asper.*
(*b*) Callus glabrous in front	4. *C. lancearius.*
2. Involucral glumes of pedicelled spikelets both awned	5. *C. Wightianus.*
B. Pedicel of upper spikelets not half as long as the sessile spikelets	
I. Lower sheaths compressed	6. *C. montanus.*
II. Lower sheaths terete	
1. Leaves, peduncle and branches of panicle glabrous	7. *C. polyphyllus.*
2. Leaves, peduncle and branches of panicle not glabrous	8. *C. Aucheri.*

1. **Chrysopogon Gryllus,** Trin. Fund. Agrost. 188 ; Nees Gen. Fl. Germ. Monocot. i, t. 93 ; Benth. Fl. Austral. vii, 537.—*Andropogon Gryllus*, Linn. Cent. Pl. ii, 33 ; Hack. Monogr. Androp. 550 ; Host. Gram. Austr. ii, 1, t. 1 ; Sibth. Fl. Græc. i. t. 67 ; Duthie Grass. N. W. Ind. 22, Fodd. Grass. N. Ind. 40 ; Hook. f. in F. B. I. vii, 187 ; Collett Fl. Siml. 602, fig. 191.—*A. echinulatus, glabratus et Royleanus*, Steud, Syn. Gram. 395, 397.—*Chrysopogon glabratus*, Trin. in Mem. Acad. Petersb. ser. 6, ii (1833), 318.—*Rhaphis Gryllus*, Desv. Opusc. 69.—*R. echinulata*, Nees in Royle Ill. Bot. Himal. 417.—*Pollinia Gryllus*, Spreng. Pugill. ii, 10 ; Reichb. Ic. Fl. Germ. t. 54.—*Apluda Gryllus*, Presl. Cyp. & Gram. Sic. 55.—*Holcus gryllus et pallidus*, Br. Prodr. 199.

Description : Stems simple, forming dense hard tufts, erect, 15 cm. to 1·5 m. high ; nodes smooth. Leaves 15–45 by 4–8 mm., linear, acute, glabrous or hirsute, margins serrulate ; sheath keeled above, glabrous or pubescent. Panicle large, 12–20 cm., rhachis angular, scabrid, axils bearded, branches long, 5–10 cm., capillary, spreading, simple or branched, usually very many in a whorl and bearing 2–4 spikes, tips obliquely truncate and densely bearded. Sessile spikelets 5–8 mm., callus straight, acute. Lower involucral glume coriaceous, 2-toothed, dorsally rounded with 2 muricate or mamillate keels or channels, shining, smooth or scaberulous, margins broadly involute, upper chartaceous, hyaline, lanceolate, mucronate or aristulate, awn equalling the spikelet or shorter, keel and sides bristly above the middle. Lower floral glume linear-oblong, obtuse, nerveless, upper linear, minutely 2-toothed, awn minute or 12–35 mm. long. Pale small, oblong, glabrous. Pedicelled spikelets rather longer than the sessile, terete, lanceolate, acuminate ; pedicels glabrous or ciliolate. Lower involucral glume acuminate or aristulate, 5–9-nerved keels

ciliate above, upper lanceolate, acuminate, ciliate. Floral glumes narrower, ciliate, awn of upper half the size of the glume.

Locality : N. Kanara : Halyal (Talbot 2088 !).

Distribution : Temperate Himalaya from Kashmir to Sikkim, 4,000-9,000 ft. Khasia Hills, 4,000-5,000 ft., westwards to N. Africa and S. Europe, Australia.

2. **Chrysopogon aciculatus**, Trin. Fund. Agrost. 188 ; Duthie Grass. N. W. Ind. 22 (*acicularis*), Fodd. Grass. N. Ind. 39 ; Benth. Fl. Hongk. 424, Fl. Austral. vii, 538.—*Andropogon aciculatus*, Retz. Obs. v (1789), 22 ; Roxb. Fl. Ind. i, 262 ; Grah. 238 ; Hack. Monogr. Androp. 562 ; Hook. f. in F. B. I. vii, 188 ; Cke. ii, 984. —*A. acicularis*, Willd. Sp. pl. iv, 906.—*Rhaphis acicularis*, Desv. Opusc. 69.—*R. trivalvis*, Lour. Fl. Cochinch. 553 ; Trin. Sp. Gram. Ic. t. 8, 9.—*Centrophorum chinense*, Trin. Fund. Agrost. 106, t. 5.— Rheede Hort. Mal. xii, t. 43.

Description : Cke. l. c.

Locality : Konkan : Alibag, sandy shore (Ezekiel !).—*N. Kanara :* Karwar, sea-shore (Sedgwick and Bell 5070 !) ; Jog, hills (Hallberg and McCann A272 !).

Distribution : More or less throughout India, Ceylon, Tropical Asia, Australia, Polynesia.

Uses : According to Haines the leaves which lie close to the ground escape to a large extent the lips of cattle. The plant is a pest on account of the sharp callus and small awns sticking to the clothes.

3. **Chrysopogon asper**, Heyne ex Wall. Cat. n. 8784.—*Andropogon asper*, Heyne in Herb. Rottler ex Hook. f. in F.B.I. vii, 189.

Description : Stem 30–90 cm., leafy below, very slender above. Leaves distichous, 30-45 cm. by 12–18 mm., broadly linear, acute cordate, coriaceous, flat, smooth, 11-nerved, midrib very slender, spinulose beneath, margins spinulosely serrulate, and with a few long tubercle-based cilia towards the broad semi-amplexicaul base ; sheaths broad, compressed, laxly hirsute, lower ones 12 mm. broad, keeled, armed with scattered tubercle-based hairs. Panicle 18 cm. long, narrow, of many whorls of short, unequal, simple, smooth, erect branches bearing solitary rarely 2 erect spikes, tips very shortly bearded. Sessile spikelets 6 mm. long, pale, coriaceous, callus up to 2 mm., long villous all round. Lower involucral glume hispid beneath, the tip strongly compressed above ; upper with the keel and sides more or less hispid above the middle, awn as long as the glume or shorter. Lower floral glume shorter than the upper involucral, narrow, obtuse, 2-nerved, ciliate, upper consisting of the linear, hyaline, 3-nerved base of the awn, awn 35–50 mm. long. Pedicelled spikelets 8 mm. long, narrowly lanceolate, 7-nerved, pale, shining, keels ciliate ; pedicels very shortly rufous-villous on both margins, excised at the tip in a semi-circle ; lower involucral glume thin, tip 2-dentate, nerves strong, sub-equidistant, or the 3 lateral on each side submarginal, margins narrowly incurved, keels ciliolate from base to tip, upper lanceolate, acuminate, 3-nerved, ciliolate. Lower floral glume linear-oblong, 2-nerved, ciliate, upper narrowly lanceolate, 1-nerved.

Locality : N. Kanara : Tinai (Talbot 2564 !).

Distribution : Madras : Pulicat Hills.

4. **Chrysopogon lancearius** Haines in Haines Bot. Bihar and Orissa 1036.—*Andropogon lancearius*, Hook. f. in F. B. I. vii, 190 ; Cke ii, 985.

Description . Cke. l. c.

Locality : Deccan : Panchgani (Blatter and Hallberg B 1230;).—*S. M. Country*: Castle Rock (Woodrow). Seems to be very rare in the Presidency.

Distribution : Sikkim Himalaya, Behar, Chota Nagpur, Orissa, W. Peninsula.

Uses : A good fodder according to Haines.

5. **Chrysopogon Wightianus**, Nees ex Steud. Syn. Gram. 397.—*Andropogon Wightianus*, Steud. Syn. Gram. 395 ; Hook. f. in F. B. I. vii, 191.—*A. aristulatus*, Hochst. ex Steud. Syn. Gram. 397 ; Hack. in Monogr. Androp. 556.—*A. breviaristatus*, Steud. l. c. 396.—*Rhaphis orientalis*, Desv. Opusc. 69.—*R. Wightianus*, Nees ex Steud. l. c.

Description : Very variable in habit. Stems short or long, erect or ascending from a short stout creeping stock. Leaves 7–25 cm. long, linear, acute, rigid, from glabrous to pubescent on both surfaces and with sometimes tubercle

based hairs, spinulosely serrulate ; sheaths glabrous, lower ones compressed ; ligule very short, villous. Panicle 7-13 cm. long, contracted, lower branches long, few in a whorl, rhachis and branches minutely hairy ; spikes solitary, green or brownish. Sessile spikelets subcylindric, 4 mm. long, callus long, densely bearded with rusty hairs all round. Lower involucral glume laterally compressed above, minutely truncate, glabrous below, hispid above, obscurely 4-nerved, tip 2-dentate, upper chartaceous, hispid above on the keel and sides, tip 2-lobed, awn as long as the glume or shorter. Lower floral glume linear-oblong, 2-nerved, ciliate, upper consisting of an awn with a narrowly dilated 2-lobed base, awn 50-65 mm. long, column hispid. Pedicelled spikelets nearly 12 mm. long, lanceolate, pubescent ; pedicel truncate, margins shortly villous. Lower involucral glume glabrous or pubescent, 7-nerved, awn longer than the glume, keels ciliate, upper lanceolate, 3-nerved, awn as long as the glume or shorter. Lower floral glume oblong, 2-nerved, ciliate, upper very narrow, ciliate, nerveless.

Locality : S. M. Country : Castle Rock (Bhide!). — *N. Kanara :* Jog to Sidderpur, open grass land (McCann A273!).

Distribution : Madras, Nilgiris, Burma, Assam. (Hackel mentions a specimen gathered in Ceylon but, according to Hooker f., it seems to be a starved specimen of *Chrysopogon zeylanicus*, Thw.).

6. **Chrysopogon montanus**, Trin. in Spreng. Neue Entdeck. ii, 93; Haines Bot. Bihar and Orissa 1037.—*Andropogon monticola*, Schult. Mant. (1824), 665 · Kunth Enum. Pl. i, 506 ; Steud. Syn. Gram. 395 ; Hack. Monogr. Androp. 557 (excl. var. *velutinus*); Hook f. in F. B. I. vii, 192, *cum omnibus var.*; Cke. ii, 985 ; Hole in Ind. Forest Mem. i (1911), 108.—*A. Sprengelii*, Kunth Rev. Gram. 166.—*Pollinia fulva*, Spreng. Pugill. ii, 93—*Andropogon Trinii*, Steud. Syn. Gram 395 ; Hack. Monogr. Androp. 558. — *A ciliolatus cæruleus et increscens*, Steud. l. c.—*Chrysopogon ciliolatus*, Boiss, Fl. Or. v. 458 (excl. var. *Aucheri*, Boiss); Duthie Grass. N. W. Ind. 22.—*C. cæruleus*, Duthie l. c. 23, Fold. Grass. N. Ind. 39, t. 60.—*C. increscens*, Nees ex Steud. l. c. 396.—*C. Wightianus* var. *leucanthus*, Thw. Enum. Pl. Zeyl. 366.—*C. serrulatus*, Trin. in Mem. Ac. Petersb. ser. 6, ii (1833), 318, Spec. Gram. t. 331.— *C. Esenbeckii*, Arn. in Steud. Syn. 395.—*Raphis ciliolata et cærulea*, Nees ex Steud. Syn. 396, 395.

This synonymy requires an explanation. *Chrysopogon montanus*, Trin. as understood in this place comprises Hackel's two species *Andropogon monticola* Schult. and *A. Trinii*, Steud., and is identical with Hook. f.'s. *A. monticola*, Schult. with all its varieties.

Hackel has two species and he distinguishes them by the following characters :

A. monticola : Upper involucral glume of sessile spikelet keeled, the keel from the base up to $\frac{2}{3}$-$\frac{3}{4}$ of its length densely pectinate ciliate with long, rigid, rufous hairs, shortly white hispid in the upper $\frac{1}{4}$.

A. Trinii : Upper involucral glume of sessile spikelet keeled below the apex only, keel white-ciliate, the lower $\frac{2}{3}$-$\frac{3}{4}$ not keeled and glabrous.

Hook. f. in F. B. I. makes of these species two varieties : var *monticola* proper and var. *Trinii*, and includes them under *A. monticola*, Schult., adding a third variety : var. *robustus*.

At the same time Hooker confesses: ' I am unable to classify the varieties of this common and variable plant in accordance with geographical areas or other considerations. This, if possible, must be effected by field-botanists in India. There is every gradation from the coarsely hirsute keel of *monticola*, to the perfectly smooth of some states of *Trinii*; from the awnless to long awned gl. I of the pedicelled spikelets, and from the glabrous to the pubescent of the same organ ; the colour of which affords no character ; nor does its length, or that of the cilia on its keels. '

Cooke (ii, 985) has adopted the name *A. monticola*, Schult. with Hooker's description and evidently also the latter's varieties. But his opinion does not count in this case as he has not seen any specimens from the Presidency and ' was therefore ' as he says himself, ' unable to fix definitely the variety to which the Bombay species belong. They will probably belong to var. *Trinii* H. f.' What induced Cooke to say that they probably belong to var. *Trinii* we cannot understand, especially as Hooker came to the conclusion that he was not able to classify the varieties according to geographical areas.

We have examined a great number of specimens from all parts of the Presidency, except Sind, Cutch and Kathiawar and we have been able to separate

many into the two varieties. They exhibit almost the same distribution and often both are found in the same locality, with this exception that var. *Trinii* has not been observed in N. Kanara, Gujarat and the Konkan. But we must also mention, and this is the most important point, that we saw many specimens all over the country which could not be classed under either variety, and it would require many new varieties if we wanted to give a name to all the different variations. And even then they would be forms only and not varieties.

Haines seems to have felt the same difficulty when he tried to classify the *montanus* material of Bihar and Orissa. He distinguishes five forms. If we wanted to follow the same method for our area, we doubt whether double the number of forms would yield satisfactory results.

Stapf describes the specimens from Tropical Africa under the name of *C. montanus* var. *tremulus*, Stapf. He calls it ' one of the several races which constitute the rather polymorphic species *C. montanus*, Trin., whose area includes Southern Africa, Madagascar and India. The var. *tremulus* approaches very closely the var. *elatior*, Stapf, a large-spikeleted parallel to the var. *serrulatus*, Stapf (*Chrysopogon serrulatus*, Trin.) and differs from it apparently only in the almost quite smooth rhachis and branchlets (a few sharp-pointed hairs may be found under a high power) and the pedicels, which are glabrous almost up to the middle, and not ciliate from the base.' It seems to us (it may look like presumption on our part to criticize our veteran and highly merited agrostologist) that it is somewhat risky to found new varieties of a protean species on a few specimens only.

According to Hole all the 3 varieties mentioned by Hooker ' appear to vary greatly, as regards their habit and vigour of growth, in response to the moisture conditions of the habitat and also according as whether, or not, the plants are habitually grazed, cut for fodder, or periodically burnt. The colour of the cilia of glume II of the sessile spikelet (pale or white in *robustus* and rufous in *monticola*), accordingly, appears to be the chief difference in the habit, and these forms appear to have different and fairly defined areas of distribution (*monticola* occurring chiefly in Central and Southern India, while *robustus* is mainly found in N. India, in the outer N. W. Himalayas and Sub-Himalayan tract).' Hole who studied the varieties *robustus* and *Trinii* both from herbarium specimens and in the field has observed that the plant at Dehra Dun gradually and imperceptibly passes from the typical *robustus* to the typical *Trinii*. We are justified in stating that a similar transition takes place between *monticola* and *Trinii* in Western India. (Of Central and Southern India we have no experience). We have therefore a gradual transition from *robustus* to *Trinii* at Dehra Dun, and from *Trinii* to *monticola* in W. India and consequently, we are not allowed to consider Hooker's varieties as good varieties.

Vern. Names : Sunthia Khad (Dohad), Agiva, Gogar, Ghora, Dand, Pandhari Kusal (Poona), Kare Hullu (Bijapur).

Description : A very variable perennial grass. Stems usually slender, erect or geniculately ascending, glabrous, sometimes robust, simple or branched, 30 cm. to 1·2 m., but often attaining 2 m., slightly compressed, solid, developing usually axillary leafy and flowering branches from all the upper nodes except the one next below the panicle. (The branches growing within the sheaths push the latter away from the stem which often results in a characteristic fan-shaped appearance.) Blade of uppermost leaf of flowering stem usually mucroniform, but attaining 8 cm., of lower leaves up to 43 cm. long and 8 mm. broad, linear acuminate, tapering from the base, scabrid on margins, sometimes also scabrid dorsally on midrib, and scaberulous above, especially towards the apex, often ciliate towards the base with tubercle-based hairs, at least when young ; sheath glabrous, compressed, keeled, especially of the lower leaves, shorter or longer than the proper internode ; ligule a minute membranous rim. Panicle 5-15 cm. long, ovate to subcylindric, yellowish to purplish, of several whorls of few or many capillary flexuous very unequal branches bearing solitary spikes, branches of flowering panicle more or less horizontally spreading, of the fruiting panicle erect and closely appressed to the rhachis, rhachis and branches smooth or scaberulous. Spikelets in clusters of 3, a central sessile hermaphrodite one with 2 lateral pedicelled male ones, the clusters being terminal and solitary on the capillary branches of the panicle. Sessile spikelets laterally compressed, 4-7 mm. long, tip of peduncle brown-bearded, clavate, callus short, with oval

scar and dense beard. Lower involucral glume laterally compressed, narrow-oblong, embracing the margins of the upper, chartaceous 2–4-nerved, hispidly ciliate dorsally on keel towards the apex or almost glabrous, often scaberulous dorsally on nerves and minutely pubescent with appressed hairs dorsally near margin, apex subtruncate or 2-dentate. Upper involucral glume laterally compressed, broader than lower, obtusely keeled, subcoriaceous, 3-nerved, margins broad, hyaline, membranous, ciliate or not, very variable with regard to its hairiness, sometimes almost glabrous, at other times hispidly ciliate dorsally on keel with long white or rufous hairs more or less from base to apex, sometimes also pubescent, or minutely villous dorsally on keel and lateral nerves, awned, awn 2·5–6 mm. long, apex entire or 2-lobed. Lower floral glume ½ the length of to subequal the upper involucral glume, linear, hyaline, ciliate, nerveless or indistinctly 1–3- or more-nerved, apex obtuse. Upper floral glume consisting of the narrow 3-nerved base of the awn, basal ½ or ⅔ hyaline, membranous, upper portion chartaceous, awn geniculate, 10–18 mm. long, but also reaching 37 mm. (including the twisted column), margins ciliate or not, apex entire or 2-lobed. Pale sometimes present, very narrow, 1·25 mm. long. Lodicules 2, cuneate, glabrous. Anthers 3, up to 3 mm. long, yellow or purple. Stigmas 2, laterally exserted at base of spikelet, yellow. Pedicelled spikelet dorsally compressed, subequal the sessile spikelet; pedicel less than half the sessile spikelet, usually about ⅓ the spikelet, densely ciliate on both margins with stiff rufous or white hairs, the upper of which are shorter than to subequal the spikelet. Lower involucral glume lanceolate, membranous, 5–7-nerved, minutely pubescent with appressed hairs dorsally, especially towards the apex, or almost glabrous, sometimes ciliate dorsally on midrib and marginal nerves, especially towards the apex acute or shortly awned. Upper involucral glume subequal to the lower, 3-nerved, margins incurved, long ciliate, apex acute or mucronate, glabrous dorsally. Floral glumes linear, hyaline, ciliate, nerveless or indistinctly nerved. Pale sometimes present, as in sessile spikelet, but slightly longer, very narrow.

The flowers are much visited by small bees.

Locality : Gujarat : Mahal-Dangs, elevation 800 ft., rainfall 100″ (Sedgwick and Bell 5391 !) —*Khandesh:* Tapti River (Blatter and Hallberg 5476!); Bhusawal (McCann 5224 A !) ; Nandgaum, Bori River (Blatter and Hallberg 3827 !) ; Bori, Tapti Island (Blatter and Hallberg 5146 !) ; Amalner, Bori River (Blatter and Hallberg 4455 !).—*Konkan :* Sion Creek (Sabnis A 231 !) ; Matheran (D'Almeida 9958 !).—*Deccan :* Khandala to Karjat (Blatter and Hallberg A 232 !) ; Kirkee (Talbot !) ; Pashan (Gammie !) ; Mangiri, 8 miles E. of Poona (Gammie !) ; Katraj (Gammie !) ; Pasarni Ghat (Blatter and Hallberg B 1209 !).—*S. M. Country :* Dumbai (Talbot 2317 !) ; Badami (Talbot 2926 !) ; N. W. of Dharwar (Sedgwick 3141 !); Dharwar, dry pasture land, elevation 2,400 ft., rainfall 34″ (Sedgwick 1817 !) ; Konankeri, elevation 1,800 ft., rainfall 35″ (Sedgwick and Bell 4439 !) ; Haveri (Talbot 2189 !).—*Kanara :* Jog to Siddhapur, open grass land (Hallberg and McCann A274 !). This species forms patches of many individuals, or combines with other individuals to form associations of a few species.

Distribution : Throughout India, especially in hilly tracts, from the N.W. Himalaya southwards, ascending to 6,000 ft., extends to Ceylon, Burma, Afghanistan, Tropical and S. Africa, Madgascar.

Uses : In Bihar and Orissa this grass is considered to be a valuable fodder, and Hole, writing of the Siwalik Division, calls it one of the most valuable fodder grasses. In Mount Abu, according to Lisboa, it is reckoned as a good fodder grass and the grain is used as food by the natives. But the same writer, under the name of *Andropogon serrulatus*, Trin. (= *Chrysopogon montanus* var. *Trinii*) remarks: 'Said to be good fodder, used much in Poona, but reports from other places unfavourable.' (J. C. Lisboa, List of Bombay Grasses, Bombay (1896), 81).

The last statement might find an explanation by a suggestive note made by Hole (l. c. 111) : 'So far as the local (Dehra Dun) plant is concerned specimens with the more hairy glume II tend to occur in localities where there is a scarcity of available moisture, both on the dry ridges and slopes of the Siwalik Hills and also (rarely) on water-logged soil, and the writer believes that the characters which have been utilized to define these varieties vary in response to the factors of the habitat and particularly in response to the available water supply. Provided that the development of the plants has not been interfered

with by grazing, grass-cutting, or other agency, those plants with the more hairy glume II are usually less robust and less coarse, or rank, than the others, and they are therefore as a rule most valued for fodder and are distinguished locally by the vernacular name of *dhaula*, whereas the coarser plants with smooth glume are called *gurla*. As this grass affords a valuable fodder and is sometimes cultivated, in consequence, it is important to determine the extent to which its characteristics are constant. If, as suggested above, they depend on the available moisture, it is obvious that cultivation of this grass on good agricultural land, with a large quantity of available moisture, would result in producing an inferior class of rank, coarse fodder.'

7. **Chrysopogon polyphyllus**, Blatter & McCann, *comb. nov.*—*Andropogon polyphyllus*, Hook. f. in F. B. I. vii, 194 (*qui habet* Hack. mss. in Herb. Duthie).—*A. Aucheri*, var. *polyphyllus*, Hack. in Herb. Duthie.

Description : Stem 60–90 cm. high, as thick as a crow-quill or more, stiff, simple or fastigiately branched, quite glabrous. Leaves crowded or not, 15–25 cm. by 2–4 mm., narrow, rigid, acuminate, flat, pale glaucous-green, glabrous on both surfaces, coriaceous, midrib and nerves very slender, margins minutely scaberulous ; sheaths terete, appressed, hard. Panicle 10–13 cm. long, oblong, subsecund, dense-flowered, very pale, branches 6–12 mm., very unequal, in many closely approximate whorls, smooth, peduncle slender, quite glabrous. Sessile spikelets 4 mm. long drooping, white or pale purplish, callus long, 1½ mm. long, obtuse, bearded at the very base only with long fulvous hairs. Glumes as in *C. montanus*. Lower involucral glume obtuse, glabrous, keel ciliate towards the tip ; upper not awned, keel glabrous or ciliate. Upper floral glume with an awn 3–8 mm. long, nearly straight, pale. Pedicelled spikelets narrowly lanceolate, acuminate, glabrous, 7-nerved, eciliate, not awned, rather longer than the sessile ; pedicels naked, villous at the tip only.

Can easily be distinguished from *C. montanus* by the stout naked callus which is bearded at the base only, and by the naked pedicels which are long-villous only at the tip.

It differs from the next species, *C. Aucheri* by its size, the long, glabrous, glaucous leaves and the glabrous peduncle and branches of the panicle.

Locality : Gujarat : Porbandar (Bhide !) ; Dohad (Bhide !) ; Watrak River on rocks (Sedgwick 1165 !) ; Daman (Bhide).—*Deccan :* Dhond, river-bank (Bhide !).

Distribution : Central Provinces. W. Peninsula.

8. **Chrysopogon Aucheri**, Stapf in Kew Bull. (1907), 211.—*Andropogon Aucheri*, Boiss. Diag. ser. 1, fasc. 5 (1844), 77 ; Hook. f. in F.B.I. vii, 195; Cke. ii, 986.—*A. Aucheri*, var. *genuinus*, Hack. Monogr. Androp. 560.—*Chrysopogon ciliolatus*, var. *Aucheri*, Boiss. Fl. Or. v, 458.

Description : Cke. l. c.

Stapf thinks that *C. Aucheri* comprises several geographical races and that the one from which the species was first described extends from Arabia through Southern Persia and Baluchistan to Sind. He characterizes it ' by the lower glume of the pedicelled spikelet being usually awnless or in any case much more shortly awned than the upper, by the glume awns not being ciliate or ciliate only at the base, and by the longer beards of the pedicels.'

Locality : Sind : Gizri (Sabnis B777 !) ; Jemadar ka Landa near Karachi (Stocks).

Distribution : Sind, Baluchistan, Afghanistan, S. Persia, Arabia (not Africa).

30. ARTHRAXON Beauv. Agrost. 111 ; Cke. ii, 967.

Species about 20, in the tropical and subtropical regions of the Old World.

We retain the 6 species mentioned by Cke. l.c. His *A. lanceolatus*, Hochst. will be slightly restricted under the name of *A. serrulatus*, Hochst., the name *A. lancifolius*, Hochst, will be substituted for *A. microphillus*, Hochst., and *A. quartinianus*, Nash, will take the place of *A. ciliaris*, Beauv.

Key as in Cke.

1. **Arthraxon inermis**, Hook. f. in F. B. I. vii, 145 ; Cke. ii, 968.

Description : Cke. l.c.

Locality : Konkan : Okda Forest, Thana District (Ryan 718 !); Wada Range, Thana District (Ryan 692 !) ; Matheran (Woodrow !); Marmagoa (McCann !). —*Deccan* : Mahableshwar (Sedgwick and Bell 4513 !, Woodrow) ; Purandhar

(McCann 5592 !); Khandala (McCann 9950 !, 9740 !).—*S. M. Country :* Derikop woods (Sedgwick 1845 !) ; Castle Rock (Gammie 15678 !).

Distribution : W. Peninsula, apparently endemic.

2. **Arthraxon serrulatus,** Hochst. in Flora (1856), 188 ; Stapf in Fl. Trop. Afr. ix, 163 —*A. lanceolatus*, Hack. in Monogr. Androp. 348 (excl. var. *echinatus*) ; Duthie, Grass. N. W. Ind. 17 ; Hook.f. in F.B.I. vii, 143 (*partim excl. Batratherum echinatum*, Nees in Edinb. Phil. Journ. xviii, (1835) 181 ; *Andropogon echinatus*, Heyne ex Steud. Nomencl. ed. 2, 91 ; *Arthraxon echinatus*, Hochst. in Flora (1856), 188 ; *Andropogon lanceolatus*, Roxb. Fl. Ind. i, 257) ; Cke. ii, 968 (*partim*). *A. lanceolatus* var *genuinus*, subvar. *serrulatus*, Schweinf. in Bull. Herb. Boiss., 2. ser. ii, 10.—*Andropogon serrulatus*, Link Hort. Berol. i, 241 (*quoad specimen, descriptio partim erronea* ?); A. Rich. Tent. Fl. Abyss. ii, 458.—*A prionodes*, Steud. Syn. Pl. Glum. I, 383.—*Batratherum lanceolatum*, Nees in Edinb. New Phil. Journ. xviii (1835), 181.—*B. serrulatum*, Hochst., ex Steud. l.c.

This species includes all the material of the Nileland of Tropical Africa, of tropical Arabia and the greater part of the Indian specimens which, up to now, were ranged under *Arthraxon lanceolatus*, Hochst. as understood by most authors.

It has been pointed out by Stapf that *Arthraxon lanceolatus*, Hochst., was founded on *Andropogon lanceolatus*, Roxb., a Coromandel plant, which has larger and wider long-awned spikelets with the lower involucral glume very minutely muricate towards the tips only. Neither of these names can, consequently, be mentioned as synonyms of *Arthraxon serrulatus*.

Description.—A perennial grass ; rhizome short, emitting fascicles of closely set culms and innovation shoots, which are more or less thickened below and covered with reddish silky cataphylls. Stems rather slender, up to 90 cm. high, many-noded, usually finely pubescent, sometimes glabrous, with vegetative branches below and usually solitary flowering branches above, the latter subfastigiate. Leaf-blades lanceolate to ovate-lanceolate, setaceously acuminate, with a caudate amplexicaul base glaucous or greenish, 2·5–5 cm. long, 12–18 mm. wide, margins cartilaginous, ciliate with the cilia springing from tubercles, smooth, very finely pubescent below or glabrous, primary lateral nerves about 8–11 on each side, fine, slightly raised below; ligule 1–2 mm. long, rounded, membranous; sheaths terete, tight, slightly shorter than the internodes or exceeding them in the leafy shoots, more or less hairy with tubercle-based hairs and often softly pubescent at the nodes, the uppermost frequently glabrous. Racemes 2–5 nate, slender, greenish or suffused with purple or violet, 3-over 5 cm. long on a short common axis, the fascicles borne on a slender peduncle, shortly or far exerted from the supporting bladeless or almost bladeless sheath ; rhachis fragile shortly bearded at the nodes ; joints narrowly linear, 3·3–6·3 mm. long, hairy on the back and sides, or the lowest almost glabrous, hairs increasing upwards to more than 2 mm.; pedicels very similar, but much shorter and more slender. Sessile spikelets narrowly lanceolate-linear to linear slightly tapering upwards up to 7·4 mm. long (not including the awn), glabrous ; callus very short, puberulous. Glumes 4. Lower involucral glume chartaceous, 6 mm. long, lanceolate, with a minutely truncate hyaline tip, very convex on the back, which is smooth or more often muricate along the 4 indistinct or faintly raised inner, spinulously muricate along the outer nerves, margins hyaline, comparatively wide ; upper linear-lanceolate in profile, membranous, 3-nerved, glabrous or nearly so. Lower floral glume linear, acute, up to 4 mm. long, hyaline, nerveless or obscurely 1-nerved at the base ; upper membranous at the base, hyaline upwards, narrowly lanceolate-linear in profile, 2-dentate, with the teeth minute, sometimes produced into short capillary bristles, delicately 3-nerved, awned from near the base, awn 8–15 mm. long, very fine, kneed about the middle, twisted below. Anthers up to 3 mm. long. Grain bacilliform about 4·2 mm. long. Pedicelled spikelet male, linear-lanceolate, acute, about 5 mm. long. Involucral glumes subequal, lower herbaceous-chartaceous, acute, scaberulous along the outer and slightly so on the 4–5 inner nerves or almost smooth, upper slightly shorter, membranous, otherwise as in the sessile spikelet. Lower floral glume as in the sessile spikelet, upper linear-oblong, obtuse, nerveless, muticous.

Locality : Sind : (Stocks 642).—*Gujarat :* Morvi, Kathiawar (Woodrow).—*Deccan :* Lonavla (Woodrow) ; Pashan, tank (Gammie !). Panchgani (Blatter

and Hallberg B1277!).—*S. M. Country :* S. W. of Dharwar (Sedgwick and Bell 4436!) ; Derikop (Sedwick 2022!) ; Belgaum, Fort wall (Sedwick 3013 !).

Distribution : More or less throughout India, Tropical Arabia and Tropical Africa (Nileland).

3. **Arthraxon Meeboldii,** Stapf in Cke. ii, 969, in Kew Bull. (1908), 449.

Locality : Western Ghats : Khandala, in open grassland on a hillside, 600 m. (Meebold 9132) ; Khandala, common (McCann 9949 !, 9948 !) ; Lonavla, common (Bhide !, McCann !); Panchgani (Blatter and Hallberg B1238 !, B1225 !), Tableland (Blatter 3804 ;); Mahableshwar (Sedgwick and Bell 4523). —*N. Kanara* : Tinai (Talbot 2569 !).

Distribution : W. Peninsula, apparently endemic.

4. **Arthraxon lancifolius,** Hochst. in Flora (1856), 188 ; Stapf in Fl. Trop. Afr. ix, 165.—*A. microphyllus*. Hochst. in Flora (1856), 188 ; Hack. Monogr. Androp. 351, *incl.* var. *lancifolius* ; Hook.f. in F.B.I. vii, 147 ; Cke. ii, 970 ; Haines Bot. Bihar and Orissa 1026.—*A. Schmidtii*, Hochst. (1856), 189.—*A. minor*, Hochst. l.c. 188, *partim.*—*A. Schimperi*, Hochst. l.c. *partim.*—*A. molle*, Balf. f. Bot. Socotra 315.—*A. ciliaris*, Henriq. in Bolet. Soc. Brot. xiii, 133, *non* Beauv.—*Andropogon lancifolius*, Trin. in Mem. Acad. Petersb. 6 ser., ii (1833), 271.—*A. molle*, Duthie Grass. N.W. Ind. 17.—*A. multicaulis*, Steud. Syn. Pl. Glum. i, 383.—*Batratherum molle*, Nees & Arn. in Edinb. New Phil. Journ., xviii (1835), 181 ; Aitchis. Cat. Panj. Pl. 174.—*B. Schimperi*, Nees ex Hochst. l.c. 179 —*Psilopogon Schimperi*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 447.—*Pleuroplitis ciliata*, J. Schmidt Beitr. Fl. Cap. Verd. 152.—*P. Schimperi*, Regel in Bull. Acad. Petersb. x (1866), 369.—*Lucæa ciliata*, Steud. l.c. 414.

Description : Cke. l.c.

Locality : Gujarat : Surat (Herb. Dehra Dun !, Cooke !).—*Konkan :* Tungar hill, Thana District (Herb. Econ. Bot. Poona !); Parel (Herb. Econ. Bot, Poona !); Kurla (Garade !); Salsette (Jacquemont 713).—*Deccan :* Trimbak, Nasik District (Herb. S. X. C., Bombay !).—*S. M. Country :* Belgaum Fort walls (Sedgwick 3012 !); W. of Dharwar, banks of road, in forest (Sedgwick 1851 !); Castle Rock (Bhide !).—*Kanara :* Karwar (Talbot 1308 !) Yellapore (Talbot 2084 !).

Distribution : More or less throughout India, Ceylon to Tonkin and S. W. China, tropical Africa (Upper Guinea, Nileland).

5. **Arthraxon quartinianus,** Nash in North Americ. Fl. xvii (1912), 99, Merrill in Phillip, Journ. Sc. Bot. vii (1912), 229; Stapf in Fl. Trop. Afr. ix 166.—*A. major*, Hochst. in Flora (1856), 188.—*A. coloratus*, Hochst. l.c.—*A. plumbeus*, Hochst. l.c. 189.—*A. violaceus* Hochst. l.c.—*A. Schimperi*, Hochst. l.c. *partim.*—*A. ciliaris*, Rendle in Cat. Afr. Pl. Welw. ii, 138, *non* Beauv.—*A. ciliaris*, subsp. *quartinianus*, Hack. Monogr. Androp. (*excl.* vars. *Hookeri et glabrescens*).—*Alectoridia quartiniana*, A. Rich. Tent. Fl. Abyss. ii, 448, t. 99.—*Lucæa major*, Steud. Syn. Pl. Glum. i, 414 ; Hochst. l.c. 179 — *L. plumbea et violacea*, Steud. l.c.—*L. Schimperi*, Hochst. in Flora (1856), 180 (the genuine).—*Pleuroplitis plumbea*, Nees ex Steud. l.c.—*P. violacea*, Nees ex Steud. l.c.—*P. major*, Regel in Bull. Acad. Petersb. (1866), 369, *partim*,—*P. quartiniana*, Regel l.c. 376,*partim.*—*Andropogon violaceus*, Heyne ex Steud. l.c.—*A. Alectoridia*, Steud l.c. 383.

We wish to substitute *A. quartinianus*, Nash in place of *A. ciliaris*, Beauv. This latter species which was described in 1812 has been emended repeatedly since then, and that to such an extent that it is scarcely possible to recognize the original plant. Hackel made five subspecies : *Langsdorffii*, *submuticus*, *nudus*, *Quartinianus*, and *Vriesii*, and nine varieties. The subspecies were arranged by him in two leading groups :

1. Joints of rhachis glabrous, or with a few scattered hairs towards the tip (*Langsdorfii*, *submuticus*, *nudus*).

2. Joints of rhachis, at least the upper, more or less ciliate (*Quartinianus*, *Vriesii*).—To these two groups Hooker f. added a third one (F.B.I., vii, 146):

3. Spikes silkily villous, spikelets 5-7 mm. long, lower involucral glume entire or minutely 2 toothed, awn 12 mm. or more. (This is *Arthraxon cuspidatus*, Hochst., considered by Hackel as a distinct species.

Arthraxon quartinianus, Nash, and adopted by Stapf l. c., covers part of the subspecies *Quartinianus* in Hackel's group 2, including var. *Quartinianus*

s. str. and var. *coloratus*, but excluding var. *Hookeri* and var. *glabrescens*. Quartin's specimen No. 14, collected in Abyssinia, and representing a form with large spikelets, has, according to Stapf, to be considered as the basis of the species, whilst Schimper's 1532, the type of *Arthraxon coloratus*, stands for the other extreme.

Arthroxan quartinianus, Nash, includes all the material of the Bombay Presidency that has come under our observation.

The rest of *A. ciliaris*, Beauv. *et auctorum* has to be studied separately, but as the material lies outside the Presidency we leave it to other botanists to work out their respective material.

Description : Annual. Stems very slender, ascending from a branched, sometimes prostrate and rooting base, from 8–30 cm. high, smooth, glabrous or finely puberulous below the inflorescence, with solitary or 2 to 3-nate branches above, internodes mostly exserted. Leaf-blades ovate-lanceolate to oblong-lanceolate from a cordate amplexicaul base, finely acuminate, 25 to over 50 mm. long by 6–12 mm. broad, flaccid, with scattered tubercle-based hairs on both sides, ciliate towards the base, primary lateral nerves 3-4 on each side, very fine ; ligules membranous, ciliolate, short, truncate ; sheaths lax, the upper very often more or less inflated and bladeless, more or less hirsute in the upper part with tubercle-based hairs and densely ciliate along the upper margins, nodes shortly bearded. Racemes 1 to about 9, in fascicles, born on filiform, ultimately long exserted peduncles, 2·5–15 cm. long, very slender, flexuous ; rhachis fragile ; joints 3·3 mm. long, usually shortly ciliate, but the uppermost cilia sometimes up to 1·6 mm. long, sometimes glabrous or nearly so ; pedicels reduced to a minute point or subule. Spikelets solitary, sessile, oblong-lanceolate in profile, somewhat oblique, laterally compressed, including the very minute glabrous or minutely puberulous callus, 3·3–4·2 mm. long. Involucral glumes subequal, lower subchartaceous, acute, scaberulous along the very slender 7–9 nerves or almost smooth towards the base, upper obliquely lanceolate to linear-lanceolate in profile, acute or minutely mucronate, 3- (rarely 5-) nerved, eciliate. Lower floral glume oblong, obtuse, hyaline, obscurely 2-nerved, shorter by $\frac{1}{3}$ than the involucral glumes, upper narrowly linear-lanceolate in profile, 2–2·7 mm. long, awn from near the base, usually 6·3 mm. long, more rarely down to 4·2 or up to 8·5 mm. long, very delicate, kneed and twisted below the middle. Stamens 2.

Locality : Gujarat : Chamargaon (Woodrow).—*Khandesh :* common (McCann !).—*Konkan :* very common (McCann !).—*Deccan*. Mahableshwar (Sedgwick and Bell 4501 !) ; Panchgani (Blatter and Hallberg B1244 !, B1252 !, B1257 !, B1266 !, B1273 !, B1290 !) Khandala, very common (McCann !).—*S. M. Country :* S. W. of Dharwar (Sedgwick and Bell 4434 !) ; Dharwar (Sedgwick 3098 !) ; Gadag (Talbot 2304 !) ; Belgaum (Ritchie 796A).—*Kanara:* Halyal (Talbot 2161 !) ; Yellapore (Talbot 1057 !).

Distribution : From Bihar southwards to Ceylon, Tropical Africa (Nileland, Upper and Lower Guinea, Mozambique District), introduced into Jamaica and Guadeloupe.

6. **Arthraxon jubatus**, Hack. Monogr. Androp. (1889), 358 ; Hook. f. in F. B. I. vii, 147 ; Cke. ii, 970.

Description : Cke. l.c.

Locality : Konkan : (Law, Stocks).—*Deccan*: Kori Fort, 12 miles south of Lonavla (Woodrow) ; Khandala, damp rocks (Hallberg 9788 !) ; Lohagad Fort, top (McCann 9789 !).

Distribution : W. Peninsula, apparently endemic.

31. Capillipedium, Stapf in Fl. Trop. Afr. ix, 169.

Annual or perennial grasses. Stems slender, simple or branched, sometimes very copiously, often bearded at the nodes. Leaf-blade with a rather conspicuous white midrib. Panicles delicate, when much divided the branchlets at length more or less divergent. Spikelets small, 2-nate, one sessile, the other pedicelled, similar in shape but differing in sex, in 1–2- (rarely up to 8-) jointed racemes at the ends of the capillary primary and secondary and often tertiary or even quaternary branches of a loose panicle ; joints and pedicels finely filiform, longitudinally grooved and hyaline in the groove, disarticulating horizontally ; sessile and pedicelled spikelets deciduous, the former with the adjacent joint and pedicel. Florets 2 in the sessile spikelet, lower reduced to

an empty glume or quite suppressed in the pedicelled spikelets, upper hermaphrodite ; one male or neuter, in the pedicelled spikelet. Sessile spikelet dorsally compressed, awned, callus small, shortly bearded. Involucral glumes equal, membranous to subherbaceous ; lower 2-keeled, with narrow inflexed margins ; upper boat-shaped, 3-nerved, keeled, grooved on both sides along the obtuse keel. Lower floral glume hyaline, nerveless, upper consisting of a hyaline, linear stipe, firmer upwards, passing into a slender awn. Pale 0. Lodicules 2, minute, glabrous. Stamens 3. Stigmas exserted laterally, longer than the styles. Grain oblong-ellipsoid or oblong, dorsally slightly compressed; embryo exceeding $\frac{1}{2}$ of the grain. Pedicelled spikelet awnless, glume, if present, hyaline, nerveless.

Species 6, in tropical and subtropical Asia, Polynesia and Australia, tropical Africa.

Three species, described by Cooke (ii, 981, 982) under *Andropogon assimilis*, Steud., *A. Hugelii*, Hack., and *A. filiculmis*, Hook. f. belong to this genus.

I. Stems more or less suffrutescent below, stiff, erect
   1. Nodes of stem glabrous ; callus shortly bearded ... ... 1. *C. assimilis.*
   2. Nodes of stem bearded ; callus densely villous ... ... 2. *C. Hugelii.*

II. Stems decumbent and interlaced, very weak, filiform ... ... 3. *C. filiculmis.*

1. **Capillipedium assimile,** A. Camus, Graminées in H. Lecomte. Fl. Générale de l'Indo-Chine 7 (1922) 314 ; Haines Bot. Bihar and Orissa (1924), 1028 (*A. Camus prior fecit combinationem novam*).—*Andropogon assimilis*, Steud. in Zoll. Syst. Verz. (1854), 58 ; Syn. Gram. (1855), 397 ; Hook. f. in F. B. I. vii, 179 ; Cke ii, 981.—*A. montanus*, Benth. Fl. Hongk. 423, *non* Roxb., *excl. syn.*; Hack. Monogr. Androp. 490, *excl. syn.*—*Chrysopogon pictus*, Hance in Ann. Sc. Nat. ser. 5, v (1866), 252.—*C. glaucopsis*, Duthie Grass. N. W. Ind. 22.—*Raphis repens*, Nees ex Steud. l. c.

Description : Cke. l. c.

Locality : Khandesh : Toranmal, growing among Strobilanthus (McCann 9671 !).—*Konkan:* Above Kenery Caves (McCann 9959 !).—*Deccan :* in dry forest, between Mahableshwar and Panchgani, at 4,000 ft. (Sedgwick and Bell 4738 !).—*Kanara :* Jugglepet, road side, common (Talbot 1386 !).

Distribution : Temperate Himalaya, Khasia, Behar, N. Bengal, Rajputana, Central India, W. Peninsula, Java, China, Japan.

2. **Capillipedium Hugelii,** Blatter & McCann, *nov. comb.*—*Andropogon Hugelii*, Hack. Monogr. Androp. 492 ; Hook. f. in F. B. I. vii, 180 ; Cke. ii, 982.

Description: Cke. l. c.

Locality : Khandesh : Toranmal (McCann 9672 !).—*Konkan :* Mulgaum (McCann 3664 !).—*Deccan* : Khandala, St. Xavier's Villa (McCann 9423 !) ; dry forests between Mahableshwar and Panchgani (Sedgwick 4738 !) ; Panchgani (Blatter and Hallberg B1321 !, McCann !).—*S. M. Country :* Deciduous forests west of Dharwar (Sedgwick 4498 !).—*Kanara :* Halyal (Talbot 2082 !) ; Ecumbi to Mungod (Hallberg and McCann A288 !).

Distribution : Rajputana, Central Provinces, Central India, W. Peninsula.

3. **Capillipedium filiculme**, Blatter & McCann, *nov. comb.*—*Andropogon filiculmis*, Hook. f. in F. B. I. vii, 181 ; Cke ii, 982.

Description : Cke. l. c.

Locality : Konkan : Trombay (McCann A286 !).—*Deccan .* Khandala to Karjat (Blatter and Hallberg A287 !) ; Igatpuri (Blatter and Hallberg 5117 !) ; Poona, in rocky places (Jacquemont 310) ; Donshi, Mawal Districts (Woodrow 26) ; Purandhar (McCann 5570 !).—*S. M. Country :* forests near Dharwar (Sedgwick 1854 !).

Distribution : W. Peninsula, apparently endemic.

32. Amphilophis, Nash in Britt. Man. Fl. N.U.S. ed. i, 71 ; Stapf in Fl. Trop. Afr. ix, 171.

Perennial grasses. Stems slender, simple or branched, bearded or beardless at the nodes. Panicles mostly subdigitate with a short primary axis, rarely the racemes on branches of the second order ; racemes always shortly peduncled,

Spikelets small, 2-nate, one sessile, the other pedicelled, similar in shape or the pedicelled reduced and smaller, the latter always different in sex except sometimes the lowermost pair which may be homogamous (male or neuter), on the fragile rhachis of many-jointed shortly peduncled racemes; joints and pedicels filiform, longitudinally grooved and hyaline in the groove, disarticulating horizontally; sessile and pedicelled (always ?) spikelets deciduous, the former with the adjacent joint and pedicel. Florets 2 in the sessile spikelets, lower reduced to an empty glume, upper hermaphrodite, 2 or 1 in the pedicelled spikelet, the lower male or neuter, the upper neuter or usually quite suppressed. Sessile spikelet dorsally compressed, awned; callus small, shortly bearded. Involucral glumes equal, thinly chartaceous to membranous; lower 2-keeled, with narrow sharply inflexed margins; upper boat-shaped, 3-nerved, acutely keeled. Lower floral glume hyaline, nerveless, upper a hyaline linear stipe, firmer upwards, passing into a slender awn. Pales 0 or very minute. Lodicules 2, minute, glabrous. Stamens 3. Stigmas exserted laterally usually low down, longer than the styles. Grain oblong, obtuse, dorsally slightly compressed; embryo about half the length of the grain. Pedicelled spikelet awnless, glumes, if present, hyaline, nerveless.

Species probably over 25, mostly in Tropical Asia.

Cke. (ii, 977–981) mentions 8 species which belong to the section *Amphilophis* of *Andropogon : Andropogon compressus*, Hook. f., *A. Woodrowii*, Hook. f., *A. pertusus*, Willd., *A. Kuntzeanus*, Hack., *A. ensiformis*, Hook. f., *A. concanensis*, Hook.f., *A. intermedius*, Cooke (*non* R. Br.), *A. odoratus*, Dna. Lisboa. All these are now being transferred to the new genus *Amphilophis*, Nash.

Key to the species (after Cke.)

A. Racemes digitate or fasciculate, the lower longer than the rhachis of the inflorescence
  I. Lower involucral glume of sessile spikelets villous below the middle
    1. Lower involucral glume not pitted
      (*a*) Upper involucral glume mucronulate ... 1. *A. compressa.*
      (*b*) Upper involucral glume obtuse ... 2. *A. Woodrowii.*
    2. Lower involucral glumes pitted ... ... 3. *A. pertusa.*
  II. Lower involucral glume of sessile spikelets glabrous below the middle (sparsely silky in *A. ensiformis*)
    1. Nodes of stem densely bearded ... 4. *A. Kuntzeana.*
    2. Nodes of stem glabrous
      (*a*) Leaves reaching 12 mm. broad ... 5. *A. ensiformis.*
      (*b*) Leaves reaching 3 mm. broad ... 6. *A. concanensis.*
B. Racemes panicled, the lower branches shorter than the rhachis of the inflorescence
  I. Non-aromatic; sheaths terete ... ... 7. *A. glabra.*
  II. Aromatic; sheaths compressed ... ... 8. *A. odorata.*

1. **Amphilophis compressa,** Blatter & McCann, *comb. nov. Andropogon compressus*, Hook. f. in F.B.I. vii (1896), 172; Cke. ii, 977.

Description : Cke. l.c.

Locality : Deccan : Khandala, plain behind the Saddle (Hallberg 9657!, Bhide!); Lonavla (McCann 9433!); Mawal (Woodrow!); Poona (Woodrow).

Distribution : Western Peninsula, apparently endemic.

2. **Amphilophis Woodrowii,** A. Camus. *Andropogon Woodrowii*, Hook. f. in F.B.I., vii (1896), 173; Cke. ii, 978.

Description : Cke. l. c.

Locality : Deccan : Khorbasa, Mawal Districts (Woodrow); Pand, 20 miles W. of Poona (Woodrow!).

Distribution : Western Peninsula, apparently endemic.

3. **Amphilophis pertusa,** Stapf in Fl. Trop. Afr. ix, 175; Haines Bot. Bihar and Orissa 1030.—*Holcus pertusus*, Linn. Mant. Alt. 301.—*Andropogon pertusus*, Willd. Sp. Pl. iv, 922; Beauv. Agrost. 131, t. 23, fig. 2; Roxb. Fl. Ind. i, 258; Hack. Monogr. Androp. 479 (vars. *genuinus et Wightii*); Duthie

Grass. N.W. Ind. 21 (*excl. Syn.*), Fodd. Grass. N. Ind. 38, t. 25; Boiss. Fl. Or. v. 464; Balf. f. Bot. Socotra 316; Hook. f. F.B.I. vii, 173; Cke. ii, 978.—*Lepeocercis pertusa*, Nees ex Steud. Syn. Pl. Glum. i, 364.

Vern. Names : Ghanga, marvel (Satara, Sholapur, Poona), payen, palva, palvan.

Description : Cke. ii, 978. A very variable plant. We must confess we find it impossible to follow various authors who have described a number of varieties. It would be easy to increase their number on merely morphological grounds, but the results would be highly unsatisfactory. It is only from genetical tests that we can expect to get an insight into the natural variations of this and other species of this genus.

Locality : Gujarat : Perim Island, Gulf of Cambay (Blatter 3814 !).—*Konkan :* Daman (Bhide !); St. Xavier's College compound, Bombay (McCann 9630 !, 9631 !).—*Deccan :* Nasik (Bourke 11 !); Rahuri (Nana A278 !); Khandala, Campoli (McCann 9961 !); Pashan (Gammie !); Lonavla (Woodrow); Agricultural College, Kirkee (Bhide !); Poona (Cooke); Panchgani (Blatter and Hallberg B1236 !), on edge of Tableland (Blatter 9962 !), on roadside 4,000 ft. (Sedgwick and Bell 4699 !); Satara (Lisboa); Sholapur (Lisboa); Joonur (Talbot !).—*S.M. Country :* W. of Dharwar, elevation 2,000 ft., rainfall 35″ (Sedgwick and Bell 4494 !); Dharwar, elevation 2,400 ft., rainfall 34″ (Sedgwick and Bell 4488 !); Kunur, elevation 2,000 ft., rainfall 35″ (Sedgwick and Bell 4953 !); Badami (Talbot 2944 !); Haveri (Talbot 2233 !); Gokak (Sheodye !).—*Kanara :* Halyal (Talbot 2080 !, 2106 !).

Distribution : More or less throughout India, chiefly in the drier parts, Ceylon, Afghanistan, Arabia, tropical Africa (Upper Guinea, Nileland, Mozambique District).

Uses : A good fodder grass. (See W. Burns, L. B. Kulkarni and S. R. Godbole : A study of some Indian grasses and grasslands. Mem. Dept. Agr. in India, xiv (1925), 47, 48.)

4. **Amphilophis Kuntzeana**, Haines Bot. Bihar and Orissa 1031.—*Andropogon Kuntzeanus*, Hack. Monogr. Androp. 478; Hook. f. F.B.I. vii, 175; Cke. ii, 979.

Description : Cke. l. c.

Locality : Konkan : (Stocks).—*Deccan :* (Woodrow 153 !); Mawal (Woodrow).

Distribution : Bihar, Central Provinces, W. Peninsula.

5. **Amphilophis ensiformis**, Blatter & McCann, *comb. nov.*—*Andropogon ensiformis*, Hook. f. in F. B. I. vii, 175; Cke. ii, 979.

Description : Cke. l. c.

Locality : Deccan : Lonavla (Woodrow !).

Distribution : W. Peninsula, apparently endemic.

6. **Amphilophis concanensis**, Blatter & McCann, *comb. nov.*—*Andropogon concanensis*, Hook. f. in F. B. I. vii, 174; Cke. ii, 980.

Description : Cke. l. c.

Locality : Konkan : Matheran (Woodrow !).—*Deccan* : Yenna River, Lingmala, Mahableshwar, 4,000 ft. elevation, 200″ rainfall (Sedgwick and Bell 4652 !); Lingmala, Mahableshwar (Blatter and Hallberg B1328 !); Khandala, in water courses, common (McCann 9651 !); Manmad, river-bed (Blatter A283 !);—*Kanara:* Kalanadi River, Supa, on rocks, elevation 2,000 ft., rainfall 100″ (Sedgwick and Bell 4857 !); Halyal (Talbot 2221 !); Goond (Talbot 2202 !); Gersoppa Falls, on rocks in river bed (Hallberg and McCann A279 !).

Distribution : W. Peninsula, apparently endemic.

7. **Amphilophis glabra**, Stapf in Fl. Trop. Afr. ix, 172.—*Andropogon glaber*, Roxb. Fl. Ind. i, 271; Steud. Syn. Pl. Glum. i, 392.—*A. punctatus*, Trin. Ic. t. 328, *non* Roxb.—*A. intermedius* var. *punctatus*, subvar. *glaber*, Hack. Monogr. Androp. 487.—*A. intermedius*, K. Schum. in Engl. Pfl. Ost.-Afr. C. 98; Hook. f in F. B. I. vii, 175; Cke. ii, 980.—*A. intermedius*, var. *punctatus*, Stapf in Dyer, Fl. Cap. vii, 345.—*Amphilophis glabra*. Haines Bot. Bihar and Orissa 1028, *non* Stapf and *partim*.

It will be seen from the above synonymy that Stapf considers *Andropogon glaber*, Roxb. as the type of the species. Of *Andropogon intermedius*, R. Br. as

conceived by Hackel he includes only the var. *punctatus*, subvar. *glaber*. Haines in his Bot. Bihar and Orissa, 1028, adopts Stapf's name *Amphilophis glabra* with the following synonyms: *Andropogon intermedius*, R. Br. *inc. A. glaber*, Roxb., *A. punctatus*, Roxb. and *A. montanus*, Roxb. ?

This is evidently not Stapf's *Amphilophis glabra*. Haines includes *Andropogon intermedius*, R. Br., whilst Stapf confines his species to var. *punctatus*, Haines has *A. punctatus*, Roxb. as a synonym, Stapf excludes it expressly.

Haines' description is much wider than that given by Stapf and includes Hackel's vars. *genuinus*, *Hænkei*, *punctatus* and *glaber*, and one of his own var. *hirta*. He says in a foot-note (p. 1029): 'These varieties are after Hackel and were described before I consulted Stapf's Gramineæ in Fl. Trop. Africa, where he reduces Hackel's *intermedius* to Roxburgh's *glaber*. The names (e.g. *genuinus*) in some cases become inapplicable if Roxburgh's *glaber* is the type. Var. *Hænkei* is, I think, a distinct species and easily distinguished in the field. It should be called *Amphilophis Hænkei*.'

Haines seems to overlook the fact that Stapf's *glabra* is restricted to one of Hackel's varieties of *Andropogon intermedius*, viz., *punctatus* and that, consequently not all of Hackel's names can be applicable.

In our opinion Haines is not justified in calling his species *Amphilophis glabra*, Stapf. As it includes practically the whole of *Andropogon intermedius*, R. Br. taken in Hackel's sense he might have called it *Amphilophis intermedia*, Haines, if that name had not been preoccupied by Stapf (Fl. Trop. Afr. ix, 174).

We are not arguing the point whether Stapf or Haines is right in the treatment of *Andropogon intermedius*, R. Br. *et auctorum*; good reasons can be adduced for both cases. All we wish to say is that Haines' *Amphilophis glabra* is not *A. glabra*, Stapf.

Those who prefer to adopt Haines' *A. glabra* and Hackel's varieties might consider a remark made by Hackel himself (l.c. 487): '*A. fasciculatis Thwaites Enum. Pl. Zeyl. p.* 437 *non Roxb. complectitur varietates* β [*Hænkei*] *et* δ [*punctatus*] *formis intermediis* (*spiculis in eadem panicula mixtis*) *conjunctas. Etiam in Bengalia transitus et ipsa varietas* β [*Hænkei*] *proveniunt; in Himalaya, e. gr. pr. Simlah formæ inter* δ [*punctatus*] *et* α [*genuinus*] *intermediæ inveniuntur.*'

We adopt Stapf's conception of *A. glabra* together with his description. Dr. Stapf was kind enough to name some of our Bombay specimens.

Description: Perennial. Rhizome very short, hard, innovations extravaginal, cataphylls ovate to lanceolate, acute, hard, smooth. Stems tufted, erect or shortly ascending, to over 1 m. high, rather stout below, glabrous, 5–7-noded, simple or very sparingly branched. Leaf-sheaths terete, glabrous, smooth, the intermediate and upper mostly shorter than the internodes, nodes glabrous or the upper bearded. Blades linear, long-tapering to a setaceous point, hardly broader, not or slightly contracted at the base, up to over 30 cm. by 8·5 mm. (mostly narrower), pale green, often turning reddish or purplish, glabrous, rarely with very fine, long, spreading, white hairs at and above the ligule, smooth except at the margins, midrib rather stout to very stout downwards, lateral nerves 3-4 on each side; ligules truncate, very short, scarious. Panicle narrowly oblong, 10–23 cm. by 25–38 mm., erect, primary axis much longer than the lowest racemes, somewhat stout and (at least when mature) stiff, smooth, shortly bearded at the branch axils, otherwise glabrous and smooth; branches whorled, up to 6 in a whorl or semiverticillate, or 2-nate or solitary from the weaker nodes, straight, 25–75 mm. long, the longer divided from 12 mm. above the base, few to 7-noded, secondary branches simple. Racemes 12–38 mm. long, straight or flexuous, usually purplish, inconspicuously white-villous; joints and pedicels 2–3·3 mm. long, ciliate, uppermost cilia much longer than the rest, up to 1 mm. long. Sessile spikelet pale green or purplish throughout, including the small minutely bearded callus 3·3–3·8 mm. long. Involucral glumes equal; lower truncate, slightly concave on the back, chartaceous-membranous, hairy below the middle, more rarely glabrous, keels rigidly ciliolate upwards, intracarinal nerves 4–5, very fine, evanescent upwards with or without a pit above the middle; upper lanceolate, acute, 3-nerved, keel scabrid upwards, margins sparingly ciliate. Lower floral glume oblong, 2·7 mm. long, hyaline, nerveless, ciliate, upper an awn 6·3–12·7 mm. long, brown below, pale above the bend. Pedicelled spikelet neuter, mostly reduced to the glumes, narrowly linear-oblong to linear, 2·7–3·3 mm. long,

glabrous, of the same colour as the sessile. Lower involucral glume rigidly and minutely ciliolate, 5-9-nerved, often rolled in, not pitted, upper hyaline, nerveless, often minute.

Locality : Konkan : Penn (McCann A282 !).—*Deccan :* Pimpalgam, on the brink of a stream (Bhide !) ; Lonavla (Hallberg 9955 !) ; Khandala, St. Mary's Ravine, on a water course (McCann 9435 !).

Distribution : More or less throughout India, Tropical Asia, N.E. Australia, Tropical Africa (Upper and Lower Guinea, Mozambique District, Nileland) Madagascar.

8. **Amphilophis odorata,** A. Camus. *Andropogon odoratus*, Dna. Lisboa in Journ. Bomb. Nat. Hist. Soc. iv, (1889), 123, *cum ic.* and vi (1891), 68, 203 ; Hook.f. in F.B,I. vii, 177 ; Cke. ii, 981.

Description : Cke. l.c.

Locality : Khandesh (Lisboa).—*Konkan :* Khardi (Mrs. Lisboa).—*Deccan :* Igatpuri (McCann A281 !), Lonavla ; (Mrs. Lisboa, Bhide !) ; plain at foot of Lohagad (McCann 9956 !) ; Pand, 20 miles W. of Poona (Herb. Econ. Bot. Poona !) ; Mawal, Poona District (Woodrow).

Distribution : W. Peninsula, apparently endemic.

33. Dichanthium, Willemet in Usteri Ann. xviii (1796), 11 ; Stapf in Prain Fl. Trop. Afr. ix, 177.

Perennial or annual. Stems simple or branched, usually many-noded, bearded or beardless at the nodes. Panicles usually subdigitate with a short or very short primary axis, rarely the latter elongated ; racemes always shortly peduncled. Spikelets small, 2-nate, one sessile, the other pedicelled, similar in shape, different in sex, except the lowermost 1 or 2 pairs (sometimes 3 or 4) of each raceme which are (with occasional exceptions in *D. annulatum*) homogamous (male or neuter), in many-jointed, shortly peduncled, subdigitate, rarely subpanicled or racemosely arranged, racemes ; joints and pedicels filiform, solid, disarticulating subhorizontally except the lowest barren pairs ; fertile sessile and pedicelled spikelets deciduous, the former with the adjacent joint and pedicel. Sessile spikelet dorsally compressed, awned except the basal homogamous ones ; callus small, shortly bearded. Involucral glumes equal, thinly chartaceous, lower usually very obtuse, 2-keeled, with narrow sharply inflexed margins, upper boat-shaped, 3-nerved, acutely keeled. Lower floral glume hyaline, nerveless, upper reduced to the hyaline base of a slender awn ; pale minute or absent. Lodicules 2, minute, glabrous. Stamens 3. Stigmas exserted laterally at or above the middle or near the tips. Grain oblong, obtuse, dorsally compressed ; embryo rather more than half the length of the grain. Pedicelled spikelet awnless. Lower involucral glume oblong, many nerved, upper flat with sharply inflexed margins closing over the hyaline lower floral glume if present and the stamens, upper floral glume usually 0, never awned.

Species 10 in the tropical and warm-temperate regions of the Old World.

So far 4 species were known from the Presidency and described by Cooke under *Andropogon armatus*, Hook. f., *A. Cookei*, Stapf, *A. caricosus*, Linn. and *A. annulatus*, Forsk. To these we have added 2 new species : *Dichanthium panchganiense*, Blatter & McCann, and *D. McCannii*, Blatter.

Key to the species

A. Racemes digitate (sometimes solitary in *D. caricosus*), 25 mm. long or longer
  I. Lower involucral glumes of pedicelled spikelets armed with marginal bulbous-based bristles
    1. Lower involucral glume of pedicelled spikelet always pitted ... ... 1. *D. panchganiense.*
    2. Lower involucral glume of pedicelled spikelet not pitted
      (*a*) Ligule absent ... ... 2. *D. armatum.*
      (*b*) Ligule present ... ... 3. *D. McCannii.*

II	Lower involucral glumes of pedicelled spikelets not armed with marginal bristles	
	1. Nodes of stem glabrous; ligule a shortly ciliate small membrane ...	4. *D. caricosum.*
	2. Nodes of stem bearded; ligule large, membranous	5. *D. annulatum.*
B.	Racemes solitary, less than 25 mm. long ...	6. *D. serratalcoides.*

1. **Dichanthium panchganiense**, Blatter & McCann in Journ. Bomb. Nat Hist. Soc. xxxii (1927), 381.
Locality : Deccan : Panchgani (McCann !)
Distribution : W. Peninsula, apparently endemic.

2. **Dichanthium armatum**, Blatter & McCann, *comb. nov.—Andropogon armatus*, Hook. f. in F. B. I. vii, 197 : Cke. ii, 987.
Description : Cke. l. c.
Locality : Konkan : Stocks (teste Hook. f.).—*Deccan* : Kalsabai Hills, Nasik District (Patwardhan 1183 !); Gira Hill, Khandala (McCann 9430 ! 9431 !); Lohagad (McCann 3871 !) ; Panchgani (Blatter and Hallberg B1212 !) ; Pasarni Ghat (Blatter and Hallberg B1304 !).
Distribution : W. Peninsula, apparently endemic.

3. **Dichanthium McCannii**, Blatter in Journ. Bomb. Nat. Hist. Soc. xxxii (1927), 381.
Locality : Deccan : Panchgani (McCann !).
Distribution : W. Peninsula, apparently endemic.

4. **Dichanthium caricosum**, *A. Camus* : Note sur le genre *Dichanthium* Willemet in Bull. Mus. Hist. Nat. (Paris) 27 (1921), 549.—*Andropogon caricosum*, Linn. Sp. Pl. ed. 2 (1763), 1480 ; Hack. Monogr. Androp. 567 ; Hook. f. in F. B. I. vii, 196 ; Cke. ii, 987 ; Haines Bot. Bihar and Orissa, 1039.—For further synonyms see Hook. f. l. c.
Three authors have made the new combination *Dichanthium caricosum :* (*a*) *A. Camus* l. c. (*b*). Stapf in Ridley Fl. Malay Penins. v (1925), 210. (*c*) Haines in Bot. Bihar and Orissa (1924), 1039. *A. Camus* has therefore to be adopted as authority for *D. caricosum.*
We are not trying to describe varieties or forms of this very variable species.
Vern. Names : Marvel (Mar.), Zinzvo (Guj.).
Description : Cke. l. c.
This species can, according to Burns and others[1] be distinguished from *D. annulatum*, Stapf by the following characters :—

	Dichanthium caricosum.	*Dichanthium annulatum.*
Habit :	Big and tufted with terminal and axillary inflorescences.	Medium size with terminal inflorescences.
Nodal hairs on stem :	Short.	Long.
Colour of inflorescence :	Light purplish-green.	Purple.
Hairs of inflorescence :	Short.	Long.

Haines l. c. believes there is no single character by which *D. caricosum* can be distinguished from *D. annulatum.* ' I have,' he says, ' tested all those given in the F. B. I. and found them fail on specimens named by Sir J. D. Hooker himself ; the key characters in Bengal plants are also unworkable as applied to the same specimens, many of which have bearded nodes, and the character of spiral or subdistichous spikelets is difficult to apply. Linnæus described *Andropogon caricosus* as with solitary spikes, and Willdenough (sic !) adds ' leaves with sparse hairs and sheaths hirsute at the base ' (probably he refers to the nodes).'
In his key-characters Haines says that in *D. caricosum* the callus is glabrous. This seems to be a mistake. Hackel calls the callus *Brevissime barbatus*, Cooke has ' bearded,' Rangachari describes it as ' short and shortly hairy below.' We have always found it bearded.
Locality : Gujarat : Surat, road sides (Sedgwick 315 !).—*Khandesh :* Toranmal (McCann 9669 !) ; Tapti, N. E. of Bhusawal (Hallberg 5111 !) ;

[1] W. Burns, L. B. Kulkarni and S. R. Godbole : A Study of Some Indian Grasses, in *Mem. Dept Agr. Ind.*, xiv (1925), 46.

N. slope of Chanseli (McCann 9968!).—*Konkan :* Parsik, railway tract (McCann 9633!).—*Deccan :* Junnar (Mamlatdar of Junnar!); Shevgaon (Mamlatdar of Shevgaon!); Lohagad, half-way up (McCann 9627!); Agricultural College Farm, Poona (Herb. Econ. Bot. Poona!); Khed (Mamlatdar of Khed!); Purandhar (McCann 5570!); Bairawady, Purandhar (McCann 5075!); Panchgani (Blatter 3803!, Blatter and Hallberg B1223!); between Mahableshwar and Panchgani, elevation 4,000 ft. (Sedgwick and Bell 4743;).—*S. M. Country :* Dharwar, elevation 2,400 ft., rainfall 34" (Sedgwick 1828!).—*Kanara :* Halyal (Talbot 2427!).

Distribution : India, Burma, Ceylon, Mauritius, China.

Uses : A good fodder grass.

5. **Dichanthium annulatum**, Stapf in Prain Fl. Trop. Afr. ix, 178; Haines Bot. Bihar and Orissa 1039.—*Andropogon annulatus*, Forsk. Fl. Aegypt.-Arab, (1775), 173; Duthie Fodd. Grass. N. Ind. 33, t. 20; Hack. Monogr. Androp. 570; Hook. f. F.B.I. vii, 196; Cke. ii, 988.– For further synonyms see Hook. f. l. c.

Vern. Names : Zinjoo, handi daroya, daroya (Surat), dhrow (Broach), zinzma (Charodi), jinjva (Panch-Mahals), marvel (Poona), sheda, sam-payen palvan-hullu, marwalyan-hullu (Dharwar).

Description : Cke. l. c.

Locality : *Sind :* Jamesabad (Sabnis B972!); Mirpurkhas (Sabnis B1028!, B1185!); Hyderabad (Sabnis B51!); Pad-Idan (Sabnis B515!); Larkana (Sabnis B462!); Nasarpur (Sabnis B1140!); Tatta, Kullan Kote Lake (Blatter and McCann D667!); Tatta, tombs (Blatter and McCann D668!).—Gujarat : Kabirwad (Chibber!); Nadiad Farm (Herb. Econ. Bot. Poona!).—*Khandesh :* Amboli, Bori River (Blatter and Hallberg 5148!); Dadgaum (McCann 9665!); Toranmal (McCann 9670!); Bor, Bori River (Blatter and Hallberg 4428!); Umalla, Tapti Bank (Blatter and Hallberg 5228!).—*Konkan :* Sion (McCann 3672!); Sewri (McCann 3587!); Parsik, railway line (McCann 9654!); Campoli (McCann 5356!).—*Deccan :* Kirkee to Poona, railway line (Garade 83!); College Garden, Poona (Garade!); Chattarshinji Hill, Poona (Ezekiel); Trimbak (Chibber!); Khandala, very common (McCann 5297!); Manmad Blatter 9970!); Purandhar, north foot (McCann 9421!).—*S.M. Country :* Devikop, elevation 1,800 ft., rainfall 40" (Sedgwick 3984!).—*Kanara :* Halyal (Talbot 2081!); Kulgi (Talbot 2299!).

Distribution : Tropical Africa (Nileland, Mozambique District), from Morocco through North Africa, the Orient and India to China and Australia, Pacific Islands.

Uses : Considered good fodder.

6. **Dichanthium serrafalcoides**, Blatter & McCann, *nov. comb.*—*Andropogon Cookei*, Stapf ex Woodrow in Journ. Bomb. Nat. Hist. Soc. xiii, 438 (*nomen tantum*); Cke. ii, 986 (*descriptio*).—*A.*(*Dichanthium* ?) *serrafalcoides*, Cooke *et* Stapf in Kew Bull. (1908), 450.

The systematic position of this species is somewhat doubtful. Cooke already found that it does not agree with Hackel's subgenus *Dichanthium*, but he adds: 'It is the only subgenus into which it will fit at all.' Cooke and Stapf, when describing the same species under a different name, remark : '*Ob spiculas secundarias infimas saepissime neutras caeterum eadem forma ac fertiles si vis ad Dichanthiun referendus, sed nulli speciei arcte affinis spiculis maiusculis in racemos spiculis Serrafalci haud dissimiles congestis insignis.*' Following this suggestion we have put it under *Dichanthium*.

Description : Cke. ii, 986.

Locality: Deccan : Lonavla (Bhide!); Khandala, Echo Point (McCann 9403!); Kalanbai Hills (Patwardhan!); Sakar-Pathar near Lonavla (Woodrow!); Mahableshwar (McCann!); Panchgani (McCann!, Blatter and Hallberg B1250!).

Distribution : W. Peninsula, apparently endemic.

34. EREMOPOGON, Stapf in Prain Fl. Trop. Afr. ix (1917), 182.

Perennial or annual grasses. Stems slender, simple below, more or less branched above, the branches often gathered in fastigiate bundles, each supported by a bladeless sheath and terminated by a solitary raceme. Spikelets small, 2-nate, one sessile, the other pedicelled, similar in shape, different in sex, on the fragile rhachis of many-jointed solitary spatheate racemes which are

frequently gathered in fastigiate bundles, rarely the lowermost 1-3 pairs homogamous; joints and pedicels filiform, compressed, solid or slightly grooved, disarticulating horizontally; spikelets deciduous, the sessile with the adjacent joint and pedicels. Sessile spikelet dorsally compressed, awned; callus small, shortly bearded. Involucral glumes equal, thinly chartaceous to membranous, lower 2-keeled, with narrow inflexed margins, upper boat-shaped, 3-nerved, acutely keeled. Lower floral glume hyaline, nerveless, upper reduced to a hyaline upwards firmer linear stipe passing into a slender awn. Stamens 3. Stigmas exserted laterally near the middle of the spikelet, longer than the styles. Pedicelled spikelet awnless; somewhat similar to the sessile.

Species about 5, in the tropical and warm-temperate parts of the Old World.

Cooke knew one species from the Presidency which he described under the name of *Andropogon foveolatus*, Del. We add *Eremopogon Paranjpyeanum*, Blatter and McCann.

1. Lower involucral glume of sessile spikelet 4-nerved ... ... 1. *E. foveolatus*.
2. Lower involucral glume of sessile spikelet faintly 5–7-nerved ... ... 2. *E. Paranjpyeanum*

1. **Eremopogon foveolatus**, Stapf in Prain Fl. Trop. Afr. ix (1917), 183.—*Andropogon foveolatus*, Del. Fl. Egypte 16, t. 8, fig. 2; Duthie Fodd. Grass. N. Ind. 35, t. 22; Hack. Monogr. Androp. 402; Hook. f. F. B. I. vii, 168; Cke. ii, 977.—*A. strictus*, Roxb. Fl. Ind. i, 260.—*A. monostachyus*, Spreng. Pug. ii, 9.—*Hypogynium foveolatum*, Haines Bot. Bihar and Orissa (1924), 1041.

Description: Cke. l. c.

Locality: *Sind*: Sehwan to Laki, foot of hills (Sabnis B 651!).—*Gujarat*: Road to Lasandra (Chibber!); Bhuj Hill, Cutch (Blatter 3765!).—*Khandesh*: Umalla, Tapti Bank (Blatter and Hallberg 5222!); Bhusawal (McCann 4243!); Bor, Bori River (Blatter and Hallberg 4309!); Naradana (Blatter and Hallberg 5180;).—*Konkan*: Parel, poor specimen (McCann 5373!).—*Deccan*: Panchgani, roadside, elevation 4,000 ft., rainfall 60″ (Sedgwick and Bell 4735!); Yeola (Herb. Econ. Bot. Poona!); Arangaon, Ahmednagar (Ryan!); Chattarshinji Hill (Ezekiel!); Deolali (Blatter 4550!); Manmad (Blatter A261!); Panchgani (Blatter and Hallberg B1245!).—*S. M. Country*: Dharwar, elevation 2,400 ft., rainfall 34″ (Sedgwick 1825!); Haveri (Talbot 2229!).

Distribution: Tropical Africa (Upper Guinea, Nileland), Canaries, from Egypt and Tropical Arabia to the drier parts of India.

2. **Eremopogon Paranjpyeanum**, Blatter & McCann, *comb. nov.*—*Andropogon Paranjpyeanum*, Bhide in Journ. and Proc. Asiat. Soc. Beng., New series, vii (1911), 514.

Description: A delicate-looking grass. Stems slender, erect, 30–45 cm. high; upper nodes pubescent; leaves 2·5–7·5 cm. by 2 mm., subcordate at base, long-hairy on both sides, the margins thickened and minutely irregularly repand and spinulosely serrulate; sheaths glabrous; ligule a short erose membrane. Racemes solitary, 12–25 mm. long (without the awns), on a very slender peduncle. Sessile spikelets 3 mm. long. Lower involucral glume oblong, obtuse, faintly 5–7-nerved, glabrous, margins narrowly incurved, keels shortly ciliate at the apex, upper just a little longer than the lower, 3-nerved, oblong, apiculate. Lower floral glume shorter than the involucral glumes, hyaline and with ciliate margins, epaleate, upper floral glume consisting of the narrow base of the awn, just a little more than half as long as the lower involucral glume, obscurely margined and 1-nerved with 2 obscure narrow lobes at the apex, and an interposed slender, twisted, scabrid awn about 4 cm. long, bearing a bisexual flower. Pedicelled spikelets about 4 mm. long. Lower involucral glume oblong, obtuse, 7–9-nerved, margins incurved and broadly winged at the keels, wings shortly ciliate towards the apex, upper involucral glume a little shorter than the lower, oblong, acute, 3-nerved, margins ciliate. Lower floral glume shorter than the upper involucral, hyaline, ciliate, faintly 3-5-nerved, epaleate, male. Joints and pedicels compressed, obliquely truncate, $\frac{1}{2}$–$\frac{2}{3}$ as long as the sessile spikelets and ciliate with short white hairs on both sides.

Locality: *S. M. Country*: Castle Rock (Bhide!).

Distribution: So far endemic.

35. SCHIZACHYRIUM. Nees Agrost. Bras. 331. Stapf in Prain Fl. Trop. Afr. ix, 1184.

Annual or perennial grasses, rarely suffrutescent, never very tall. Stems slender. Leaf-blades folded in bud, usually narrow. False panicles varying from very loose and scanty to densely fascicled; spathes mostly very narrow, scarious, membranous or lower down herbaceous. Spikelets 2-nate, of each pair differing in sex and mostly also more or less in shape and size, one sessile the other pedicelled, on the articulate fragile rhachis of many-jointed solitary racemes terminating the culms and their branches, supported by spathes and often collected into a false panicle, the sessile spikelets falling with the contiguous joint and the accompanying pedicelled spikelet; joints and pedicels thickened upwards, often rather stout with a scarious cupuliform and more or less dentate terminal appendage. Sessile spikelets dorsally compressed or sometimes in their lower half almost terete, awned; callus short with a short beard at the very base. Involucral glumes equal or subequal, lower chartaceous to subcoriaceous, more or less convex or flat on the back with, at least from the middle upwards, sharply inflexed and mostly narrow margins, 2-keeled, the keels running out into teeth or mucros, upper thinner to membranous, narrowly boat-shaped to dorsally flattened, keeled (at least upwards), 1–3-nerved, the delicate margins ciliolate Floral glumes, ciliolate, hyaline, lower membranous downwards and often purplish, 2-nerved, upper usually 2-fid or 2-dentate, rarely entire, awned, awn from the sinus or continuing the entire valve, Pale 0 or a microscopic hyaline scale. Lodicules 2, minute, glabrous. Stamens 3, rarely 2. Stigmas laterally exserted low down; styles terminal. Grain narrowly linear in outline or tapering upwards, subterete; embryo short. Pedicelled spikelet similar to the sessile, but usually relatively broader and flatter, or more or less reduced and then sometimes quite small. Involucral glumes more or less membranous, the lower aristulate or muticous. Floral glumes, if present hyaline, ciliate, muticous.

Species about 50, in the tropics of both hemispheres.

1. **Schizachyrium brevifolium**, Nees Agrost. Bras. 332; Miq. Fl. Ind. Bat. iii, 495; Stapf in Prain Fl. Trop. Afr. ix, 187; Haines Bot. Bihar and Orissa 1042. — *Andropogon brevifolius*, Sw. Prodr. Veg. Ind. Occ. 26, Fl. Ind. Occ. i, 209; Hack. in. Monogr. Androp. vi, 363 (excl. var. *fragilis*); Duthie Grass. N. W. Ind. 19, Fodd. Grass. N. Ind. 34; Hook. f F.B.I. vii, 165.—*A. obtusifolius*, Poir. Encycl. Suppl. i, 583.—*A. parvifolius*, Roxb. Fl Ind. i, 277.—*A. tenellus* Presl. Rel. Hænk. i, 335.—*A. debilis*, Kunth Enum. Pl. i, 488.—*A. floridus*, Trin. in Mem. Acad. Petersb. 6 ser. ii, 265.—*Pollinia brevifolia*, Spreng. Syst, i, 288.

Description: Annual. Stems weak, up to 60 cm. long, usually ascending from a decumbent base, rarely erect many-noded, branched from most of the nodes: branches often 2–4-nate and dividing again, very slender to filiform, geniculate, glabrous, the lower internodes usually much compressed. Leaf-blades linear, constricted at the junction with the sheath, the lower and those of the primary branches obtuse or sub-obtuse or suddenly narrowed to a sharp point, 25–38 mm. long and 2–6·3 mm. wide, the upper and those of the secondary and tertiary branches much narrower and more acute, often glaucescent, smooth except along the margins and the lower side of the midrib, nerves very fine. Ligules membranous, very short, ciliolate. Sheaths compressed, the lower keeled, somewhat lax, glabrous, smooth, the uppermost spathe-like; leaves like the spathe of the inflorescence ultimately turning reddish. Spathes on subcapillary curved or flexuous branchlets, very narrow, acute, reaching to the base of the racemes or slightly exceeding them; racemes borne on filiform upwards clavate peduncles, slender from less than 12 mm. to slightly over 25 mm. long, 5–11-jointed; joints 2–2·7 mm. long, widening upwards from a slender base, tips 2-dentate glabrous, smooth; pedicels as long as the joints, very slender and only slightly thickened upwards. Sessile spikelets linear-lanceolate, acuminate, more or less convex on the back, pale green, about 3·3 mm. long including the minute callus, which is more or less shortly bearded, at least on the sides. Involucral glumes equal, lower thinly chartaceous, 2-dentate, scaberulous along the keels, with very fine intracarinal nerves, smooth or very minutely scaberulous on the back; upper boat-shaped, acute, 1-nerved, ciliolate. Lower floral glume elliptic, obtuse, hyaline, nerveless, ciliolate, upper 2-fid almost to the base, 1·6 mm. long, segments linear-oblong, sub-

obtuse, sparingly ciliolate. awn 8·5-12·7 mm. long. Anthers 0·5 mm. long, deep red or purple. Grain sublinear, tapering upwards. Pedicelled spikelet reduced to a minute glume, often passing indistinctly into the pedicel and produced into a bristle-like awn, about 4·2 mm. long.

Locality : S. M. Country : Badami (Talbot 2930 !).

Distribution : Widely distributed throughout the tropics.

36. Andropogon, Linn.; Stapf in Prain Fl. Trop. Afr. ix, 208.

After the restoration of Hackel's subgenera to the rank of genera, the general characters of *Andropogon* itself must be modified in many ways :

Mostly perennial grasses of various habit. Spikelets 2-nate, the sessile and pedicelled differing from one another in sex and more or less heteromorphous, all pairs similar, or if the lowest sessile spikelet male or imperfect then resembling the others. Spikes (spiciform racemes) many-jointed, fragile, paired (very rarely solitary) or corymbose (digitate or subdigitate) on terminal peduncles, embraced below by a spathe-like leaf (spatheole), frequently 2 or more pairs with their spathes subtended by a common spathe and so on to more compound branching the whole forming a false panicle ; the sessile spikelets falling with the contiguous joint and the accompanying pedicel ; joints and pedicels filiform or thickened upwards and then the tips frequently more or less cupular or auricled Sessile spikelets dorsally or laterally compressed, nearly always awned ; callus short, mostly quite obtuse, shortly bearded. Involucral glumes equal or subequal, subcoriaceous to membranous, lower flat or concave or channeled on the back with at least from the middle upwards sharply inflexed margins, 2-keeled ; upper more or less boat-shaped, keeled upwards, 3-1-nerved, sometimes aristulate. Floral glumes ciliate or ciliolate, rarely glabrous, lower hyaline, 2-nerved, upper 2-fid or 2-dentate, hyaline or firmer and sometimes substipitiform below the insertion of the awn. Pale a hyaline nerveless scale or 0. Lodicules 2, minute, glabrous. Stamens 3. Stigmas laterally exserted ; styles terminal. Grain narrowly lanceolate to oblong in outline, subterete to planoconvex ; embryo about half the length of the grain. Pedicelled spikelets often very different from the sessile in shape and less so in size, always more or less compressed dorsally, never concave or channelled on the back, sometimes reduced and then often small or quite suppressed. Involucral glumes herbaceous-chartaceous to membranous, the lower muticous or very rarely aristulate. Floral glumes, if present, hyaline, ciliate, muticous.

Species about 100, mostly in the tropics of both hemispheres.

1. **Andropogon pumilus**, Roxb. Fl. Ind. 1 (1832), 273 ; Steud, Syn. Gram. 388 ; Hook f. in F.B.I. vii, 170 ; Cke. ii, 976 ; Haines Bot. Bihar and Orissa 1044.—*A. demissus*, Steud, l.c.—*A. pachyarthrus*, Hack. Monogr. Androp. 449 ; Duthie Grass. N. W. Ind. 21, Fodd. Grass. N. Ind. t 39.

Vern. Names : Zinzvo (Surat), bærki, gondwal. lalgavat, tambrut, gondal, chiman chara, malakava.

Description : Cke. l.c.

Locality : Gujarat : Nadiad farm (Herb. Econ. Bot. Poona !) ; Surat (Dalzell).—*Khandesh :* Bhusawal (McCann 5451!) ! Bor, Bori River (Blatter and Hallberg 5116 !) ; to Naradana (Blatter and Hallberg 5207 !).—*Deccan :* Pashan (Gammie !) ; Bairawadi, Purandhar (McCann 5054 !) ; Manmad (Blatter A262 !) ; Shiuda (Sabnis A260 !) ; Panchgani (Blatter and Hallberg B1268 !, B1274 !, B1326 !).—*S. M. Country :* Haveri (Talbot 2230 !) ; Dumbal (Talbot 2318 !) ; Harsol (Sedgwick 1083 !).—*Kanara :* Karwar (Lisboa).

Distribution : Nepal, Bihar, Rajputana, Central Prov., W. Peninsula.

37. Cymbopogon, Spreng.; Stapf in Prain Fl. Trop. Afr. ix, 265.

Perennial, densely tufted and usually aromatic grasses. Leaves often very coarse. Panicles frequently much compound and contracted, spatheate. Spikelets 2-nate, those of each pair differing in sex and more or less in shape—except those of lowest pair of the lower or of both racemes which are homogamous (male or neuter)—one sessile, the other pedicelled on the articulate fragile rhachis of many-jointed paired racemes, terminating the culms and their branches ; raceme-pairs supported by a spatheole, collected into often decompound or supra-decompound spatheate panicle ; the fertile spikelets falling with the contiguous joint and the accompanying pedicel ; joints and pedicels filiform

or linear with frequently more or less cupular or auricled tips, those of the lowest pair (raceme-base) often conspicuously swollen, oblong or barrel-shaped and hard. Sessile spikelets (above the lowest) female or hermaphrodite, dorsally, rarely, laterally, compressed, awned (normally) ; callus very short, obtuse, shortly bearded. Involucral glumes equal or subequal, more or less chartaceous, lower almost flat or slightly depressed or narrowly grooved on the back, with at least from the middle upwards sharply inflexed margins, 2-keeled, upper more or less boat-shaped, keeled upwards, usually 1-nerved. Floral glumes ciliate or ciliolate (sometimes obscurely), lower entire, hyaline, 2-nerved, upper 2-fid or 2-lobed, hyaline, rarely firmer and almost stipe-like below the insertion of the awn ; column of awn, if any, smooth. Pale 0. Lodicules 2, minute, glabrous. Stamens 3. Stigmas laterally exserted ; styles terminal. Grain oblong in outline, subterete to plano-convex in cross-section ; embryo about half the length of the grain. Pedicelled spikelets usually slightly different in shape and size from the sessile, but never depressed or grooved on the back. Involucral glumes muticous, lower chartaceous to sub-chartaceous upper thinner. Lower floral glume hyaline, 2-nerved, upper 0, but usually a male flower present.

Species about 36, in the tropical, more rarely in the subtropical regions of the Old World.

Cooke mentions one indigenous (*Andropogon Jwarancusa*, Jones) and one cultivated species (*Andropogon Schœnanthus*, Linn.) belonging to this genus. We add two indigenous species and a cultivated one :

Key, mainly after Stapf :

A. Blades long, hard, rough-edged throughout, filiform to linear; lower involucral glume of sessile spikelet flat or concave between the keels

I. Raceme-joints villous all over, hairs long, more or less concealing the sessile spikelets ; awn usually a straight, very short bristle

1. Basal leaf-sheaths in dense tufts, tightly clasping, thickened below ; blades more or less filiform and flexuous, except when very short ; raceme-fascicles more or less simple ... 1. *C. Schœnanthus.*

2. Basal leaf-sheaths ultimately loosened and curled ; blades flat ; raceme-fascicles compound ... ... 2. *C. Jwarancusa.*

II. Raceme-joints bearded along the sides, but hairs not concealing the sessile spikelets ; fertile spikelets awnless ... 3. *C. citratus.*

B. Blades flat, 5–30 mm. wide, rounded to subcordate and stem-clasping at the base, of a soft texture, with smooth edges, at least in the lower part ; lower involucral glume of sessile spikelet with a narrow groove from the middle downwards corresponding to a keel inside

I. Blades 10–30 mm. wide (rarely under 10 mm.), somewhat fat, rich green, at least above ; panicles 10–30 cm. long, turning reddish when mature ... 4. *C. Martini.*

II. Blades 2–6 mm. wide, thin, glaucous ; panicles 10–20 cm. long, glaucous or straw-colour when mature ... ... 5. *C. cæsius.*

1. **Cymbopogon Schœnanthus**, Spreng. Pug. ii (1815), 15, *non* Schult.; Stapf in Kew Bull. (1906), 303-313, 352-353, in Prain Fl. Trop. Afr. ix, 268.—*C. arabicus*, Nees ex Steud. Syn. Pl. Glum. i (1855), 387.—*C. Arriani*, Aitch. Cat. Punj. Pl. (1869), 174.—*C. Circinnatus*, Hochst. ex Hack. in Monogr. Androp. 599.—*Andropogon Schœnanthus*, Linn. Sp. Pl. ed 1 (1753), 1046 (*non Hackel et plurimorum auct.*).—*A. bicornis*, Forsk. Fl. Aegypt.-Arab. (1763), 173, *non* Linn.—*A. laniger*, Desf. Fl. Atl. ii (1800), 379 ; Boiss. Fl. Or. v, 465 ; Balfour Bot. Socotra, 316 ; Hack. in Monogr. Androp. 598 ; Benth. in Hook. Ic. Pl. t. 1871.—*A. Olivieri*, Boiss. Diagn. Pl. Or. ser. i,

fasc. v (1844), 76.—*A. circinnatus*. Hochst. *et* Steud. Syn. Pl. Glum. i (1855), 387.—*A. Arriani*, Edgew. in Journ. Linn. Soc. vi (1862), 208.—*A. Jwarancusa*, subsp. *laniger*, Hook.f. F.B.I. vii. 203; Cke. ii, 976 (*var. tantum*).—*Gymnanthelia lanigera*, Anderss. in Schweinf. Beitr. Fl. Aethiop. 306 (*nomen tantum*).

For a discussion of the foundation of this species see Stapf in Kew Bull. (1906), 303-305.

Description: Perennial, compactly cæspitose, with numerous intravaginal innovations, 15-45 cm. high. Culms erect, slender, few— to 4-noded and simple below the inflorescence, terete, glabrous, very rarely with a few small hairs at the nodes. Leaf-blades semiterete, filiform, wiry, flexuous, very firm and often circinate upwards, rounded on the back, channelled on the face, or those of the culms somewhat flatter and shorter, up to more than 23 cm. long, 1 mm. in diameter, glabrous, finely scaberulous on the nerves below, though often smooth to the touch, pale, glaucous, evenly 7-9-nerved, the midrib showing only above as a broad, white band. Ligules membranous to scarious, oblong, truncate, ciliate, up to 3·3 mm. long. Sheaths very firm, smooth, glabrous, tight, those of the innovations and base of the culms widened at the base, very tough and long-persistent, straw-coloured, up to 13 cm. long. Spatheate panicle narrow, 8-30 cm. long, few—to 7-noded lower internodes 5-7·5 cm. long, upper rapidly decreasing in length, slender, glabrous; lowest primary branch rarely undivided at the base, 3-2-noded and up to 15 cm. long, usually forming up to 4-rayed tiers; lowest subtending sheaths with foliaceous blades; rays finely filiform, 2·5-3·7 cm. long, rarely to over 5 cm., glabrous; spathes narrowly lanceolate, subherbaceous, often tinged with pale purple, with a short blade or the upper bladeless and produced into a setaceous point, 3·7-4·3 cm. long, glabrous. Spatheoles very narrow, acute or with a setaceous point, 12-25 mm. long, pale or straw-coloured; peduncles finely filiform, widened upwards 3·3-4·2 mm. long, tips truncate. Racemes 2-nate, more or less divaricate, at length epinastically deflexed, 1-2 mm. long, white-villous, pale or tinged with purple, one subsessile, the other with a bare base, 1-2 mm. long, bases puberulous to pubescent in the fork, ciliate-bearded upwards, with minutely cupular and denticulate tips, that of the subsessile raceme as well as the adjacent pedicel stout, elliptic to elliptic-oblong in outline and convex on the back, ultimately more or less glabrescent and glossy; fertile joints filiform, slightly widened towards the oblique subcupular auricled tips, 2·7-3·3 mm. long, densely hairy to villous from the back and the angles; adjacent pedicels similar to the joints but more slender. Homogamous pair of spikelets one at the base of the sessile or of both racemes; the sessile spikelet of the lowest but one of the sessile raceme intermediate and imperfectly awned. Fertile spikelets linear-lanceolate, more or less acuminate, acute, including the callus 5·3-6·3 or even 7·4 mm. long, glabrous, pale green below, reddish upwards; callus short obtuse, shortly bearded. Involucral glumes equal, chartaceous, lower nerveless and shallowly concave between the acute scaberulous keels, minutely 2-denticulate, upper lanceolate-oblong in profile, acute, slightly curved on the back, 1-nerved, margins broadly hyaline upwards, ciliate. Lower floral glume linear-oblong, nerveless, hyaline, ciliolate, slightly shorter than the involucral glumes, upper very narrow, shortly 2-fid, cuneate-linear and chartaceous below the insertion of the awn, less than 3·3 mm. long, lobes broadly lanceolate, ciliate, awn up to 1 cm. long, very fine, more or less keeled at and slightly twisted below the middle; column smooth. Anthers 2 mm. long. Pedicelled spikelets male, linear-oblong, 4·2-6·3 mm. long, glabrous, more reddish than the sessile; involucral glumes subchartaceous, with 5-9 evenly distant intracarinal nerves, the upper thinner, 3-nerved; lower floral glume linear-oblong, sub-2-nerved, ciliolate, 4·2 mm. long; upper floret reduced to a male flower, or its glume present as a microscopic scale.

Locality: Sind: (Stocks 816, Woodrow); Jemadar ka Landa near Karachi (Stocks).

Distrbution: From Morocco through N. Africa, Arabia, Persia, Afghanistan, Baluchistan, Punjab, Sind.

History and Uses: See Stapf in Kew Bull. (1906), 305-313, 353.

2. **Cymbopogon Jwarancusa**, Schult. Mant. ii (1824), 458; Stapf in Kew Bull. (1906), 354; Haines Bot. Bihar and Orissa 1045.—*Andropogon Jwarancusa* Jones in Asiat. Research. iv (1795), 109; Cke. ii, 976.—*A. Jwarancusa* var.

genuinus, Hack. Monogr. Androp. 599.—*A I.* subsp. *Jwarancusa proper*, Hook. f. F. B. I. vii, 203.—*A. laniger*, Duthie Fodd. Grass. N. Ind. t. 23.

Vern. Names : Jwarankusa (i.e. fever-restrainer) (Sanskr.), khavi (Hindust.)

Description : Usually a tall grass, up to 1·8 m. high, with very aromatic roots, densely tufted, the stems from clusters of firm, persistent, finally loose and open and tortuous leaf-sheaths, more or less widened below. Leaves flat, up to 60 cm. long and 5 mm. broad, narrowly linear, filiform above and ending in a long capillard tip, ligule 0 5 mm. long, membranous. Panicles long, narrow interruptey, with very compressed, short, fascicled branches bearing spathes about 5 cm. long and spatheoles 6-18 mm. long. Racemes 1·4–1·8 cm. long, often 5 joined, joints half as long as the uppermost villi. Spikelets 3–4 pairs, green, half hidden by the 5 mm. long villi, on the joints and pedicels. Sessile spikelets 5 mm. long ; lower involucral glume flat or concave between the keels, which are neither winged nor margined (omitting of course, the ordinary inflexed margins of the glume common to the genus) or sometimes narrowly margined, scabrid or ciliolate, nerves 2–4 or 0 between the keels. Joints of rhachis and pedicels subclavate, with toothed tips. Pedicelled spikelets equal or rather longer than the sessile, narrowly lanceolate, purplish ; lower involucral glume 7–9 nerved.

Note.—This species is nearly related to *C. Schœnanthus* and the two, as pointed out by Hackel (l. c. p. 600), are not always distinguishable with certainty. 'At high altitudes,' says Stapf (l. c. 314), 'as in Kumaon and Spiti, or in the dryer parts of the Punjab, it (*C. Jwarancusa*) becomes dwarfed and narrow-leafed and forms a "transition state" to *C. Schœnanthus*. The latter is a characteristic desert plant, able to exist with a minimum supply of water. On the other hand, *C. Jwarancusa* is dependent on an, at least temporarily, abundant supply of water, and prefers the neighbourhood of rivers, or actually grows in the beds of torrents. It is not impossible, that the distinguishing characters of *C Jwarancusa* as compared with *C. Schœnanthus*, that is the robust state, the long, flat and relatively broad leaves, and the more composite panicles, are mainly due to eolaphic conditions.'

Locality : *Sind* : Karachi (Dalzell and Gibson); Bholari (Bhide !); Shikarpur (Bhide !); Umerkot, sandy plains (Sabnis B1082!); Gharo (Blatter and McCann D669! D670!) ; Gholamalla (Blatter and McCann D671!).—*Gujarat :* Ahmedabad (Dalzell and Gibson).

Distribution : Outer hillzone of the United Provinces, Kumaon, Garhwal (up to 3,000 m. or over) and westwards as far as Peshawar, Jodhpur and Jaisalmer States, Sind, Bihar.

Uses : Stapf is of opinion that this grass is very probably used along with *C. Schœnanthus*. See also Stapf (l. c. 313–314).

*3. **Cymbopogon citratus**, Stapf in Kew Bull. (1906), 357 in Prain Fl. Trop. Afr. ix, 282.—*Andropogon Schœnanthus*, Linn. Syst, ed. x (1759), 1304, not of Sp. Pl.; Roxb. Fl. Ind. ed. Carey and Wall. i (1820), 278.— *A. citratus* DC. Cat. Hort. Monsp. (1813), 78 ; Nees in Allgem. Gartenz. iii (1835), 266.—*A. citriodorum* (sic !) Desf. in Tabl. Ecole Bot. ii (1815), 15.—*A. Roxburghii*, Nees in Wight Cat. (1833), no. 1699 (*nomen tantum*) ; Steud Syn. Pl. Glum. i. (1855), 395—*A. ceriferus* Hack. in Mart. Fl. Bras ii, pt. iii (1883), 281.—*A. nardus*, var. *ceriferus*, Hack. Monogr. Androp. (1889), 605. *Sehœnanthus amboinicum*, Rumph. Herb. Amboin. v, 181, t. 72.

For the taxonomic position of this species see Stapf in Kew Bull. (1906), 330–333.

Vern. Names: Oleu cha, hirva cha (Mar.), lili cha (Guj.), vasane-hullu, kavance hullu, majjige hullu (Canarese).

Description : A tall perennial, throwing up dense fascicles of leaves from a short, oblique annulate, sparingly branched rhizome, usually barren, but occasionally giving rise to a stout erect culm up to over 1·8 m. high, 7–8-noded and simple below the panicle. Leaf-blades linear, long-attenuated towards the base and tapering upwards to a long setaceous point, up to over 90 cm. long by 16–18 mm. wide, very firm, glaucous-green, glabrous, smooth or more or less rough upwards and along the margins ; midrib somewhat stout below, whitish on the upper side ; primary lateral nerves 4–6 on each side, raised particularly above with 2–4 secondary nerves between them. Ligules very short, scarious, rounded or truncate. Sheaths terete, those of the barren shoots much widened at the base, and tightly clasping each other, narrow and separating upwards, with rounded shoulders at the mouth, 10–30 cm. long,

subcoriaceous, quite glabrous and smooth, more or less cinnamon-coloured or russet on the inside ; sheath of the culms tight, shorter than the internodes, finely pubescent or velvety at the nodes Spatheate panicle decompound to subdecompound, loose, 30 to over 60 cm. long, nodding ; internodes 4 to over 6, the longest up to 20 or 22 cm. long, rapidly, decreasing in length upwards ; lowest primary branches undivided at the base, up to over 45 cm. long, and up to 5- or 6-noded, the following forming mixed tiers of very unequal variously compound and simple rays, ultimate tiers up to 4-rayed ; rays filiform and glabrous; spathes narrow-lanceolate, acute or acuminate, 2·5–5 cm. long with narrow membranous margins. Spatheoles very narrow, linear-lanceolate to almost subulate when inrolled, 14–18 mm. long, acute or finely acuminate, reddish to rich russet. Peduncles 6–10 mm. long, glabrous. Racemes 2-nate, finally spreading at right angles or epinastically deflexed, moderately dense, 14–25 mm. long, pale, variously tinged with dull purple, loosely villous, one subsessile, the other with a slender filiform bare base, almost 2 mm. long and hairy, the pedicel of the homogamous pair also slender, though short ; fertile joints filiform, slender, 2–3 mm. long, ciliate on both sides, tips obliquely auriculate and cupular, adjacent pedicels very similar. Homogamous pair of spikelets 1 at the base of the sessile raceme, its sessile member usually slightly differing in shape from the fertile spikelets. Fertile spikelets linear to linear-lanceolate, acutely acuminate, 5–6 mm. long, reddish, glabrous; callus short, obtuse, minutely bearded. Involucral glumes subequal, lower subchartaceous, slightly depressed towards the base, otherwise flat on the back, keels acute, scaberulous above, intracarinal nerves 0 or 1, short or indistinct, upper boat-shaped, slightly curved on the back, acute, keeled upwards. Lower floral glume hyaline, linear-oblong or almost linear, sub-2-nerved, ciliolate above, slightly shorter than the involucral glumes, upper narrowly linear, acute, about 4 mm. long, usually entire and awnless, rarely more or less 2-fid with a small bristle from the sinus. Anthers 2 mm. long. Pedicelled spikelets male or neuter, linear to subulate-lanceolate, as long as the sessile, reddish, glabrous; lower involucral glume 5–9-nerved, upper 3-nerved; lower floral glume shorter to much shorter than the involucral glumes, hyaline, ciliolate, upper very narrowly linear, nerveless if present at all.

Locality : Gardens in Bombay.

Distribution : This grass is only known in the cultivated state. Probably of Indian origin, and now widely distributed over the tropics of both hemispheres. See Stapf in Kew Bull. (1906), 334.

History and uses of the Lemon-grass : Stapf l.c. 322–330. 334, 358.

4. **Cymbopogon Martini**, Stapf in Kew Bull. (1906), 359 ; Haines Bot. Bihar and Orissa 1046.—*C. Martinianus*, Schult. Mant. ii (1824), 459.—*Andropogon Martini*, Roxb. Fl. Ind. i (1820), 280.—*A. pachnodes*, Trin. in Mem. Acad. Petersb. ser. 6, ii (1833), 284. and Spec. Gram. Ic. (1836), tab. 327.—*A. Calamus aromaticus*, Royle, Essay Antiq. Hind. Med. (1837), 33 (*nomen tantum*), Illustr. Bot. Himal. (1840), tab. 280.—*A. nardoides*, α Nees, Fl. Afr. Austr. (1841), 116. —*A. Schœnanthus*, Fluck. and Hanb. Pharmacogr. (1874), 660 (*non* Linn.)—*A. Schœnanthus*, var. *genuinus*, Hack. Monogr. Androp. (1889), 609 (*partim*). —*A. Schœnanthus* var. *Martini*, Hook. f. in F. B. I. vii (1897), 204 (*exclus. synon. referentibus ad plantas Africanas*).—For the foundation of this species and its synonymy see Stapf in Kew Bull. (1906), 335–337.

Vern. Names : Geranium grass, Rusa grass ; rohisha, rosem (Sanskr.) ; rusa, gandh-bel, mirchia gandh, tikhari (Hindust.) ; rohish, roshegavat (Mar.) ; rhonse, rauns (Guj.) ; eunthi hullu, khasi hullu (Kanar.).

Description : A tall, perennial sweet-scented grass, 1·5–2·4 m. high. Stems glabrous, straw-coloured, leafy. Leaves flat, usually broad, rounded or subcordate at the base, more or less glaucous beneath, those below the inflorescence rarely under 23 cm. long by 1 cm. wide at the base, but often 2·5 cm. wide below, tapering from a little above the base or from the middle to a firm tip, glabrous except for the scabrid margins, margin sometimes smooth near the base. Spikes 2-nate, 12–18 mm. long, oblique or divaricate or less often deflexed. Peduncle about half the length of the 18–25 mm. long spatheole, several spatheoles and their peduncles from a spathe of lower order, these arranged in long usually narrowly oblong panicles not more than 3·5–5 cm. wide, but sometimes panicle with many branches and broader. Joints and pedicels slenderly clavate (excluding the much thickened lowest), about half as

long as the sessile spikelets, tips with a lanceolate tooth or 3-toothed, margins long-villous, 3·5–5 mm. long. Lower involucral glume (above the lowest spikelet) with lanceolate centre becoming oblanceolate or oblong from the keels being membranously winged above the middle, back with a vertical median depression below the middle corresponding to a ridge inside ; upper cymbiform with the dorsal keel winged above, minutely ciliate below.

Locality : Gujarat : Champanir (Chibber !) ; Ahmedabad, dry hills (Sedgwick 310 !) : Junagad, Kathiawar (Blatter 3783 !) ; Bhuj-Rhodir-Maha, Cutch (Blatter 3649 !) ; Anjar, Cutch (Blatter 3741 !).—*Khandesh* : Road to Chinchpada (Chibber !) ; Toranmal (McCann A235 !).—*Konkan* : Wada Range (Ryan 488 !) ; Gokhirva, Bassein (Ryan 41 !) ; Keltan (Ryan 392 !) ; St. Xavier's College compound (McCann 446! !).—*Deccan* : Ganeshkhind Botanic Gardens (Garade 435 !) ; Purandhar (Bhide !) ; Pashan (Gammie !) ; Modasa (Sedgwick and Saxton !) ; Khandala, very common (McCann !) ; Igatpuri (Blatter and Hallberg 4432 !) ; Purandhar (McCann 5010 !) ; Kasara, Igatpuri Ghat (McCann 4343A !) ; Panchgani (Blatter and Hallberg B1248 !, B1282 !, B1297 !, B1324 !).—*S. M. Country* : Haveri (Talbot 2180 !) ; Dharwar (Talbot 2616 !) ; Badami (Talbot 2928 !). [According to Malcolmson, ' the Rusa grass in the Deccan affects particularly the trap, more or less avoiding the granite, so much so that he was able to trace the green-stone dykes across the granite by the luxuriance of the grass ' (ex Stapf)].

Distribution : From the Afghan frontier to the Rajmahal Hills in Bengal and from the subtropical zone of the Himalaya to about 12° N., excluding the desert region of the Punjab and the greater part of the northern Carnatic.

Stapf excludes also the outer slopes of the Western Ghats, but the localities given above show that the grass is well represented in that region. For the history and uses of the Rusa grass oil *Oleum Palmarosæ seu Geranii Indici* (Palmarosa oil) see Stapf in Kew Bull. (1906), 338–341, 360.

5. **Cymbopogon caesius,** Stapf in Kew Bull. (1906), 360. in Prain Fl. Trop. Afr. ix, 287.—*Andropogon caseius,* Nees in Wight. Cat. (1833) nos. 1700b (*nomen tantum*) and in Hook. and Arn. Bot. Beech. Voy. 244 *cum descriptione* (*partim*).—*A. Schœnanthus*, var. *caesius*, Hack. in Monogr. Androp. 610 ; Schweinf. in Bull Herb. Boiss. ii, App. ii, 14 ; Hook. f. in F.B.I. 205, *exlus. fere omnibus synon.*

For foundation of this species see Stapf in Kew Bull. (1906), 344.

Description : A perennial, tufted grass, up to 1 m. high, with intra— and extravaginal innovation-shoots from a short rhizome. Culms erect or geniculate-ascending, slender, more or less wiry, frequently branched below, the branches often in fascicles from the knees, often many-noded, terete, glabrous, smooth. Leaf-blades linear from a scarcely narrowed rarely slightly rounded base, tapering to a long setaceous point, those of the culms up to over 15 (sometimes almost 30) cm. long, 2–6 (sometimes 10) mm. broad, of the innovations usually much shorter, flat, bluish-glaucous, glabrous, smooth, midrib slender, primary lateral nerves very fine, 3–4 on each side. Ligules very short, rounded, scarious. Sheaths rather firm, tight, the lowest mostly short, those placed at branching nodes at length thrown aside, inrolling or deciduous, glabrous, smooth, usually much shorter than the internodes. Spathaceous panicle narrow, mostly 7–15 cm. long, rarely much longer, sometimes reduced and small, dense or interrupted ; internodes usually 4–6, the lowest rarely exceeding a third of the panicle, the following gradually decreasing ; lowest primary branch shortly exserted from its sheath, undivided at the base, or like the following forming mixed or (upwards) simple-rayed tiers ; rays of ultimate tiers 5–3, finely filiform. 7–10 cm. long, glabrous ; lowest subtending sheaths with foliaceous blades : spathes lanceolate, acuminate—2·5—4 cm. long, subherbaceous, glaucous, sometimes turning reddish. Spatheoles narrowly lanceolate, acuminate, 14–16 mm. long, subherbaceous to scarious, turning dirty straw-colour or slightly reddish ; peduncles filiform 5-6 mm. long, glabrous. Racemes 2-nate, obliqualy erect. 12–14 mm. long, greenish, more or less white-villous, one subsessile, the other with a bare base, over 2 mm. long, finely pubescent on the inner side, clliate and thickened upwards, base of the subsessile raceme swollen, hard, fused with the equally swollen and hard adjacent pedicel ; fertile joints filiform, about 2 mm. long, glabrous on the back, densely ciliate on the sides, cilia snow-white, tips often cupular with a crenulate margin or auricle ; adjacent pedicels very similar. Homogamous pair 1 at the base of

the sessile raceme. Fertile spikelets oblong, slightly wider above the middle, subobtuse, 4 mm. long, greenish, glabrous ; callus very small, obtuse, minutely bearded. Involucral glumes equal, subchartaceous, lower minutely truncate, flat on the back with a fine median grove in the lower half, keels narrowly winged from the middle upwards, intracarinal nerves 1 on each side towards the keels, very fine ; upper narrow in profile, very acute, very narrowly winged above the middle with 1 delicate nerve on each side near the margin. Lower floral glume delicate, oblong, minutely truncate, ciliolate, nerveless, upper substipitiform, almost 3 mm long, 2-fid to the middle, segments subulate, ciliolate, awn very fine, 10–14 mm. long, bent at and twisted below the middle. Anthers almost 2 mm. long. Pedicelled spikelets male, linear to lanceolate-oblong, subobtuse, 4 mm. long, green, glabrous ; lower involucral glume slightly convex on the back, subherbaceous, about 10-nerved, the inner 6 nerves prominent, upper subhyaline, 3-nerved ; floral glume oblong, truncate, sub-2-nerved, almost 4 mm. long.

Locality : Gujarat : On sandy and gravelly hills and banks, Ahmedabad and Prantij.

Distribution : Throughout the Carnatic, Gujarat, Arabia, Somaliland.

For *history* and *uses* see Stapf Kew Bull. (1906), 342–345, 361.

(*To be continued*)

THE HOME OF THE EASTERN GORILLA

BY

MARIUS MAXWELL,

Author of 'Big Game Hunting with a Camera in Equatorial Africa'

(With a map and ten plates)

INTRODUCTION

Intending to visit a portion of the Eastern Congo and in particular the Birunga (Virunga) mountains, I left Nairobi with my companion, Mr. James Hugh Barnes, on February 11, 1925, and travelled by motor car across Uganda. We joined our porters at Kabale, a few days' march from the border of the Belgian Congo, and proceeded to Behungi (altitude 8,214 feet). From this spot, situated on the eastern wall of the great Central Depression, we enjoyed a splendid view over an extensive stretch of craterland, partly on the border-line of Western Uganda and partly in the adjoining territory of the Congo. We also gained our first view of the magnificent chain of mountains known as the Birunga volcanoes. These mountains have long been known to form the main habitat of the Birunga Gorilla [1] (*Gorilla beringeri*), named after Oscar von Beringe, who discovered the species in 1903. This is a very different animal from the lowland gorilla found in other parts of the Congo and West Africa, a young specimen of which could at one time be seen in the Zoological Gardens in Regent's Park. The Kivu, Birunga, or Eastern Gorilla is a much finer creature, the adult male being particularly impressive in appearance. The West African Gorilla differs from the Birunga Gorilla in many respects, the hair, for instance, on the head and body being considerably shorter in the Western form.

Our object was not only to acquaint ourselves with the home of this comparatively little known ape, but also to study its habits more closely. Incidentally, I wished to take a few snapshots of the animal in its native surroundings. In accordance with these intentions, over a month was spent on several of these volcanoes, with an aneroid barometer and a hand-camera as our chief equipment.

GEOGRAPHY OF THE BIRUNGA MOUNTAINS

It may perhaps be as well to preface this account of my experience with a brief description of the geographical position and the physical aspect of these mountains. This introduction, illustrated with a few photographs, may help to establish a better understanding of the habitat of the Birunga Gorilla. (See Map.)

[1] Also known as the Eastern or Mountain Gorilla.



No. 1. Mt. Mgahinga (11,400 ft.) with Mt. Muhavura (13,547 ft.) in the background.
(See Explanation of Plates.)



No. 2. Mr. James Hugh Barnes, the writer's companion, with the Porters. The precipitous peaks of Sabinio in the background.
(See Explanation of Plates.)

The Birunga Mountains proper, as the map indicates, are situated to the north-east of Lake Kivu, and present, with the eight main volcanoes, an imposing chain. This chain runs in a somewhat south-westerly direction, almost at right angles across the main depression or Central Rift, and roughly speaking separates the basin of the Congo River from that of the Nile. At their base, and extending over a large tract of country to the north as well as to the south of these volcanoes, can be distinguished a multitude of small, extinct craters overgrown with grass. These form a veritable 'craterland', and appear, when viewed from a great elevation dotted like hillocks about the floor of this great depression. Incidentally it may be observed that so much progress has been made of late years in the development of the Congo that the locality is now easy of access.

The eight main volcanoes of the Birunga range to which reference has just been made, are taking them in order from east to west :—

1. Muhavura, with an almost perfect regularity in shape, and a summit rising to a height [1] of 13,547 feet above sea-level.
2. Mgahinga, a truncated cone with slightly concave sides and a height of 11,400 feet.
3. Sabinio, with its array of jagged and precipitous peaks, and deeply furrowed slopes, attains a height of 11,960 feet.
4. Visoke, a truncated cone with almost straight sides, has a height of 12,568 feet.
5. Karisimbi, with its unpretentious flat cone, is the highest mountain in the whole range and reaches an altitude of 14,633 feet.
6. Mikeno, a massive mound with a rocky summit, as may be seen from the illustration, is perhaps the most favoured home of the Kivu or Mountain Gorilla, which is known by the local name of *Ngághi* (pronounced *Engághi*). Mikeno has a height of 14,385 feet. Then follow the most westerly craters, Niragongo (11,250 feet) and Namlagira, the lowest mountain of the whole range, with a height of 9,766 feet. Niragongo and Namlagira stand side by side together, but detached from the other six. The last two volcanoes are at present the only ones that are still active. Niragongo appears to be dying out.

The first six volcanoes can be divided into two distinct groups connected by a long and comparatively low saddle, roughly eight miles long, densely wooded, mainly with bamboo and tropical undergrowth.

The eastern group consists of Muhavura, Mgahinga and Sabinio, which stand closely side by side in a line running approximately from east to west. They form the present boundary between a corner of Western Uganda and the mandated territory known as Ruanda (Belgian occupation). Sabinio stands on the boundary of Uganda and the Belgian Congo.

The second group, consisting of Visoke, Karisimbi and Mikeno, is situated in Congo Territory, and the three volcanoes are situated

[1] The heights of the various volcanoes are taken from the Boundary Commission Maps, 1923. (Provisional Issue) Sheet $\frac{\text{South A. 35}}{\text{L}}$.

roughly at the corners of an isosceles triangle. The saddle, mentioned just now, connects Sabinio of the first group with Visoke in the second group.

These splendid mountains rise from the level of the highland plains which are already from 5,000 to 6,000 feet above sea-level. On a clear day they form a commanding array visible for many miles around.

It is locally known that the Birunga Gorilla, or as the natives call it, *Ngâghi*, occurs in both the Sabinio and Mikeno groups of volcanoes. The latter, however, is the more favoured habitat. There can be no doubt that an occasional migration may take place from the one group of mountains to the other, since the gorillas can wander across the densely forested saddle between Visoke and Sabinio without having to pass through inhabited valleys or plains. There can therefore be no question of local distinctions between the gorillas living in the two groups of mountains. Although it is not improbable that these apes occasionally frequent the two most westerly volcanoes Nirangongo and Namlagira, their presence there is apparently, not so common that these volcanoes can be regarded as permanent habitats.

The shooting of these great apes is now prohibited by the Congo Government under penalty. Although the Birunga volcanoes have recently, in 1924, been declared a closed sanctuary for gorillas, the provincial Commissioner of the Kivu District, M. Ernest Ledocte, very kindly allowed Mr. J. H. Barnes and myself to enter the reserve, on condition that we would avoid killing any of the gorillas, a condition we willingly accepted.

The absence of successful photographs showing the Birunga Gorilla in its native forests is due mainly to the following causes: Their normal habitat on these mountains lies at an altitude of between 7,000 and 12,000 feet and they live among the densely carpeted slopes, or in the thick bamboo forests, and the wooded ravines and kloofs, where the light conditions are mostly too unfavourable to allow for an instantaneous exposure. These equatorial mountain regions have in general a humid and mist-laden atmosphere, especially in the higher zones, above, say, 9,000 feet altitude. In these increased altitudes, the slopes and crags are more frequently than not enveloped in mist, with the peaks and the summits shrouded in dense clouds, or they are exposed to rains, varying from a cold continuous drizzle, with heavy showers at intervals, to a pelting tropical tornado and occasional hailstorms.

Secondly, the gorilla is averse to showing itself to human beings. Its tendency is to shun observation and, if its privacy is invaded, it retires into the densest parts of the forest undergrowth, offering little opportunity for what can only be a hurried snapshot, even with reasonable light conditions.

The vegetation on these Birunga volcanoes, especially on Mikeno and Karisimbi, can be roughly divided into three distinct zones. The lower belt, say from approximately 7,000 to 9,000 feet, consists of bamboo forests and large trees with dense undergrowth. Tangles of lianas and a variety of creeping plants hang in curtains or festoons from the tree stems or from the lofty



No. 3. Panoramic View of Mt. Mikeno (14,385 ft.) and Mt. Karisimbi on the left (14,633 ft.)
(*See Explanation of Plates.*)



No. 4. Panoramic View of Mt. Sabinio.
(*See Explanation of Plates.*)



No. 5. A Typical Forest of Mikeno (alt. about 11,000 ft.), showing Hagenia trees in tall undergrowth.
(*See Explanation of Plates.*)



No. 6. Another Forest Scene on Mt. Mikeno at 11,000 ft. alt., showing a portion frequented by Gorillas.

branches. In short, the scenery of this zone presents in many places the primeval nature of a typical Congo Forest as it is so often depicted in illustration.

The intermediate zone, say from 9,000 to about 12,000 feet altitude, as typified by the vegetation of Karisimbi and Mikeno, consists in the main of a vast undulating carpet of a chervil-like plant and stinging nettles, interspersed with giant lobelias, docks, sorrels, hemlocks and similar plants. Stately, broad-crowned Hagenia trees (*Hagenia abyssinica*) rise from among this dense undergrowth at such distances that in many places their crowns touch one another. They form, as it were, a roof that covers the undergrowth at a height of twenty-five to thirty feet from the ground, while transmitting a certain amount of light, so that the mountainous landscape below the trees remains in moderate gloom. These Hagenia trees, as may be noticed in the photographs, have mostly short, thick stems with here and there very widely diverging branches of great size. Some of these, especially the broken and decaying branches, are heavily overhung with a variety of vines and creepers and carry massive pads of rank moss and lichens. The base of the stems of old trees frequently reach a circumference of fifteen feet; their roots are exposed and are often hollowed at the base. Curtained as they are with trellises of luxuriant creepers, they form niches serving as snug resting-places and night-shelters for the gorillas of these regions. The cautious stalker, if he is fortunate, may occasionally find a gorilla peering out at him from among such thickets. Owing to the height of the surrounding vegetation, the animals are able to enter or leave these shelters without being observed. The crevices and rents of these trees constitute the favourite home of the mountain Hyrax, a small beast like a marmot in appearance, which utters a peculiar cry.

The highest zone, commencing at an altitude of approximately 12,000 feet, shows an equatorial subalpine and alpine flora beginning with patches of Giant Heath (*Erica arborea*), the stems being frequently covered with a ragged beard moss, which hangs in places in long grey-green shreds. The height which these tree heaths can reach is shown in the accompanying photograph. The foliage varies in colour from heather and dark brown to a light brown or deep red. The giant heaths appear to grow best on shallow surface soil resting upon the rugged volcanic rocks. The rock is here and there covered with great golden patches of moss or exposed in scored and precipitous patches with glistening streaks of moisture trickling from the sodden slopes and mountain ledges above. Where the layer of soil is too thin to furnish sufficient hold to the roots of these giant heaths, the heavy trees topple over. These fallen trees, enveloped as they are in thick beard moss and lichens present a curiously dismal conglomeration of dying and decaying alpine vegetation. Higher up, the lobelias with their tall poker-like tops and the giant groundsels (*Senecio johnstoni*) are the most dominant features of the flora. In the highest regions the ground is covered with Alchemillas and thick drab moss.

After these remarks upon the local conditions, we will proceed to discuss the habits of the gorilla itself.

General Habits of the Birunga Gorilla

In disposition, these apes are normally neither ferocious, nor aggressive, nor do they even appear to be quarrelsome among themselves. They naturally resent being suddenly and unexpectedly interfered with while dozing, or feeding in their secluded retreat. Except under such provocation the beast is decidedly of a retiring nature, and takes care to avoid human observation. On the other hand it may well be imagined that the gorilla offers in its appropriate mountain wilds an aspect quite different from that presented by an occasional immature specimen of the West African lowland gorilla in captivity. In the former case, it is generally met with in circumstances and surroundings that are apt to excite the imagination of the pursuer, especially after he has read the various stories of their ferocity and other alleged undesirable traits. On close acquaintance with this inoffensive inhabitant of these altitudes, it will be found that the gorilla differs in mentality very little from the other apes. A more profound study of the animals does, however, show that certain primitive human instincts exist in these anthropoids. On the other hand, it should be emphasized that there is no suggestion of any skilled movements ; the idea of these apes employing, in their wild state, sticks or stones as means of defence or offence, would strike an observer, even after a most preliminary acquaintance, as far from correct. Nature has provided these large apes, especially the old males, with ample means for safeguarding themselves against the attacks of carnivora. An occasional young one may fall a victim to the leopard, traces of which animal are fairly common in these regions, occurring even up to an altitude of 13,000 feet. The lion is not included in the fauna associated with the gorilla of the Birunga volcanoes.

The first glimpse of a gorilla in the more open parts of the Hagenia and 'wild-chervil' forests is as a rule the appearance of a large, jet-black and shaggy head set on a pair of disproportionately broad and square shoulders. Although the normal gait of the gorilla is ostensibly not that of a biped, but that of a quadruped, it frequently and unconsciously retains the erect posture. It may on occasion be seen standing, or wading through the green vegetation, moving at intervals for a few steps in an erect attitude, and reaching out for some attractive stalk. In its erect gait the gorilla stoops forward perceptibly and shows in profile the back of its shaggy head in a straight line with its somewhat inclined back. Gorillas squat about a good deal, and show a variety of comical poses, especially when picking at the soft bark of the chervil-like plants. They consume the pith of these plants, which, in certain regions appears to constitute their main diet.

Curiosity will, as a rule, prompt them to stand erect on their short, bandy legs for quite a long time and peer intently at the intruder; in such cases, however, they rarely show more than their head and shoulders, above the vegetation. The countenance of this ape, when its curiosity only is aroused, bears a most peaceful expression. The neck being very short and massive, the head is in consequence held somewhat rigidly. When scared or pursued



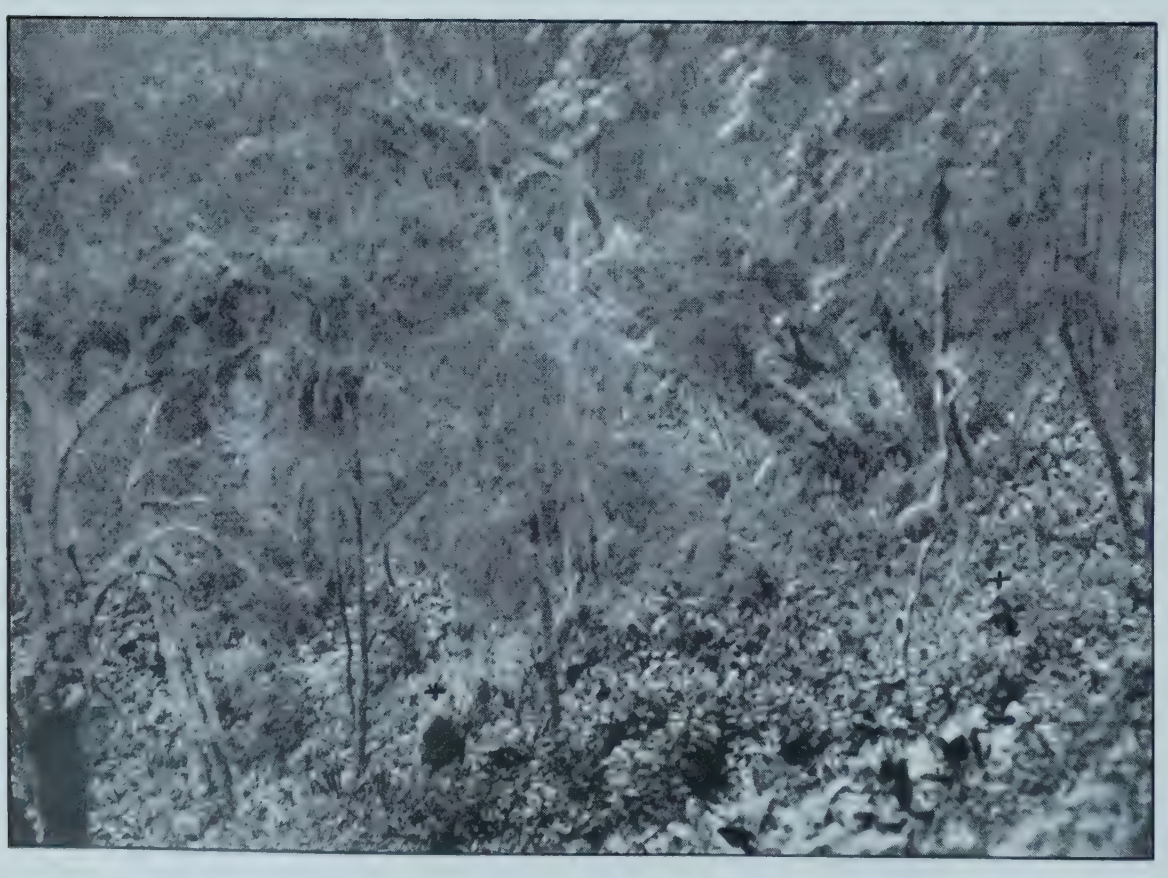
No. 7. A Forest of *Hagenia abyssinica* on Mt. Mikeno at an altitude of over 9,000 ft.
(See Explanation of Plates).



No. 8. Arboreal Heath (*Erica arborea*) and Senecio, a Giant Groundsel (*Senecio johnstoni*). Note their respective heights by comparison with the figure below the trees.



No. 9. The summit of Mt. Mikeno (14,385 ft.), showing alpine vegetation on the slopes of the peak.
(*See Explanation of Plates.*)



No. 10. A startled Female Gorilla (marked with cross in foreground) making off with her young on her back.
(*See Explanation of Plates*).

the gorilla does not take to the trees, but prefers to move silently off on all fours through the dense under-vegetation, shunning observation as much as the surroundings will permit. It is quickly out of sight, and a fleeting glimpse of its head and sloping back is all that is presented to the observer. The arms being very long in proportion to the bowed legs, it goes without saying that the body stoops less during locomotion than it does with other apes. The forepart of the body is supported by the knuckles of the hands placed on the ground. The adjoining photograph shows a startled mother-gorilla in the act of escaping with her progeny seated like a jockey and clinging to her back. I took this snapshot at a moment when the animal mounted an obstruction across her path. She was thus for an instant exposed to the camera, before disappearing in the thick, yielding undergrowth. The attitude here depicted is evidently the way they carry their infants when they are prompted to move hurriedly through the dense ground vegetation. At other times the young one may be seen encircling with its arms the neck of the seated parent, sometimes with its little feet clinging to the shaggy hair of its mother.

On the right of this picture, somewhat indistinctly, about half-way up the mountain-slope, is a sub-adult gorilla in an agitated condition and standing up among the dense forest undergrowth and exposed to its waist. The circumstances were briefly these: I happened to come suddenly upon a party of the feeding creatures. Startled by my appearance, they uttered their discordant shrill and reiterated cry of excitement previous to a hurried departure. The younger members are, on such occasions, apt to show their resentment, or terror, by antics as well as by shrill cries, thus occasionally giving the stalker time to take a hurried snapshot of his subject. It will be noticed that the mist-laden atmosphere has somewhat interfered with the clarity of the photograph, but in the circumstances it was all that the lens could be expected to give.

Differences of Sex and Age

The sexual differences in these apes are considerable. Whereas the female gorilla, which is in build and height much inferior to that of the male, invariably makes off with the stoop in the case of a disturbance, the old male of the family will, at close range, behave quite differently. The bull gorilla of the party, usually a very fine and powerful creature is on such occasions apt to give a display of his violent resentment at the sudden intrusion. The resentment is exhibited, first by a quick approach on all fours, to the accompaniment of a sharp, abrupt and reiterated sound, something between a grunt and a bark, followed by an impressive advance in an erect posture, accompanied by a quick succession of discordant screams not unlike the noises of a pig as it finds its way to the slaughter-house. The suddenness, and the fact that these demonstrations are generally carried out at uncomfortably close range, in unexpected and awkward thickets, leaves one baffled for the moment. In the cases experienced we found that once it has expended the effect of its bluff and realized that its menacing

approaches are of no avail in driving the stranger away, it turns promptly and joins the departing family group. The grotesque appearance, at close quarters, of the stocky, bowlegged creature, advancing at a toddle in an erect attitude is impressive ; with its scalp drawn down and thus bristling its hairy crest it is a sight enough to scare any wild creature of the forest. With the mouth open and the retracted lips exposing the canines at each expiration, the irritated animal then undoubtedly gives a pronounced appearance of ferocity. He approaches the intruder rapidly in his stooping attitude, on all fours, and only rises on his feet at a few yards from his adversary. The environment is usually such that it increases the effect of the sudden appearance from the undergrowth of the great shaggy head and broad shoulders. I have not seen gorillas beat their chest in such circumstances ; and I am not aware that they ever do so when in movement, as their arms then seem instinctively inclined to take advantage of any support. The noise produced by thumping on the body is occasionally heard coming from adult members of a party, and is in the absence of intruders, presumably purely an expression of exuberant spirits.

At a distance the old male may beat his chest in mild defiance of an intruder, but the performance is, I have noticed, usually carried out from some covert or in thickets where the creature imagines himself concealed from observation. The performance becomes sometimes ludicrous.

Whereas the tautly paunched belly in the male is covered with hair (as the adjoining photograph of gorilla clearly shows), the chest is bare and wrinkled, attaining with age a marked flabbiness; the armpits are likewise bare. The sound of the beating on this part of its anatomy is in the case of an old male nothing more formidable than that which a portly person can produce by the loud and repeated thumping of his naked chest with either the palm of his hand or with the closed fist ; the Kivu Gorilla appears to produce both these sounds. The impressive forest-environment and the silence which reigns over these man-forsaken regions has no doubt much to do with the elaborate descriptions of these quite natural sounds.

The females are insignificant in appearance as compared to the adult male, and are known to be from a foot to about a foot and a half shorter than the males of equal age. The female gorilla looks in its wild state more podgy, or squatter, than the male.

The photograph of the dead male gorilla, as well as those that follow of the captured young ones, were very kindly given to me by Pére G. Provoost of the White Friars Mission at Lulenga, in the Kivu District. The official seated beside the animal's body is the late Commandant Elias Arrhenius, a well-known Swedish gentleman who was in the service of the Belgian Congo Government. Arrhenius, who it will be remembered, accompanied Prince William of Sweden to these parts, was among the first to send specimens to Europe. This particular one, together with the pair of female gorillas also shot by Arrhenius, appears to have reached the Swedish Museum of Natural Science in the year 1916, although they were secured before that date.



No. 11. An adult male Gorilla.
(*See Explanation of Plates.*)



No. 12 A pair of female Gorillas secured on Mt. Mikeno.
(*See Explanation of Plates.*)



No. 13. Four captured young Gorillas.
(*See Explanation of Plates.*)



No. 14. One of the four young Gorillas
with its guardian.

It will be seen from the photographs of the young gorillas, captured in the same region (Mount Mikeno), that they differ materially from the adults. The very young ones have their whole body covered with the coarse hair except the face and parts of the hands and feet. The glabrous skin of the face is black and shiny. The nostrils are large and prominent, and the deeply set eyes almost hidden by the overhanging brows. The hair is jet-black and coarse and resembles that of the common Himalayan Black Bear. In fact, the first glimpse of a young female gorilla moving on all fours through the undergrowth reminds one much of the black bear in India. One of the four young gorillas, a female, figuring in the adjoining illustration, reached the Antwerp Zoological Gardens but died unfortunately some time towards the end of 1924. One of the warders of this Zoo, in charge of the Monkey House, informed me that it had succumbed to an abscess of some kind in the throat, after an unsuccessful operation. Its food in captivity consisted of bananas, apples and vegetables. Celery, I should imagine, would be the nearest approach to the gorillas' natural food in its mountain home, which as already stated, is a kind of wild chervil with long blanched and succulent stalks.

Another of the four specimens, if I am rightly informed, died during the sea voyage, and the remaining two perished locally in the Congo.

The capture of such young gorillas can easily be effected, in suitable localities, by creating a sudden commotion among a troop by concerted shouting and the firing of a rifle. Thus embarrassed, in the confusion the young ones are separated from the others and give an opportunity to the pursuers to close in and throw a sack, or blanket over the terror-stricken creatures. Unfortunately such a procedure is apt to involve the killing of one or two of the adults among the party.

With adult individuals, especially the males of more advanced age, the chest is bare to a well defined line about the waist, with the skin wrinkled on the breast, forming in the old males distinct creases. The back of the adult male exhibits a patch of grizzled hair, which develops with advancing age into a broad and conspicuous silver-grey band across the loins. The crest of hair growing on a fleshy swelling along the line of the sagittal suture, is very prominent in the male, much, more so than in the female. This sagittal crest is only erected to its full extent when the beast has been molested and is thoroughly roused, either enraged or terrified. The same habit is, of course, frequently exhibited by many other mammals.

It will, however, be noticed that the gorilla does not, as monkeys usually do, display their endeavour to terrify their antagonist by approaching in abrupt starts. The adult male gorilla carries his bluff further by a continuous advance in the upright attitude to within very close proximity of the intruder. By such means he is confident and no doubt accustomed to succeed in scaring the occasional Batwa hunters that venture to seek their honey and other edible forest resources in these regions. At a distance he will not embark upon this advance, but will usually content himself with

breast-beating and other signs of defiance and displeasure. In their normal mood these great apes look phlegmatic and good-natured. There is a varied individuality in their appearance and features. Chest measurements of dead specimens at sixty inches in fully-grown males have been recorded, and even a couple of inches more. These measurements would naturally be proportionately more for the expanded chest of the live animal. Although their maximum height is known to be in the neighbourhood of only six feet from the crown to the heel, the weight of an adult male exceeds that of two men of average weight. Some old males have been secured in these regions which are stated to have weighed between four and five hundred pounds. The short, bowed legs of the gorilla, supporting the heavy, pot-bellied body, the excessively broad and square shoulders and the long and powerful arms, reaching to the knees when the creature is erect, give the Kivu Gorilla its singularly stocky and massive appearance.

Arboreal Habits

Although on the whole the Kivu Gorilla is not arboreal in its habits, as can be seen at once from an examination of its hands and feet,[1] it should not be presumed that it is always a clumsy climber. In the lower forest regions of Mount Mikeno, at an elevation of approximately 8,000 feet, it is not unusual to see a young or a sub-adult gorilla climbing a tree some forty to fifty feet in height. In such a case, the favoured observer will be astonished to perceive the deliberate and, as it struck me at the time, methodical manner in which these apes are able to ascend the tall trees, in much the same way as a man climbing up a pole, fitted with cross-spokes, i. e. in an upright posture and using the human overhand movements. They can remain comfortably perched among the top branches, every now and then phlegmatically reaching out their long hairy arms and plucking at some favourite morsel in the way of a fruit or some young shoots. It is surprising to see how well they blend with the foliage and how little of their body is exposed to the observer, giving no chance of a successful snapshot. In the cases witnessed, I have invariably seen them descend by the stem by which they ascended, and in the same way. They seem to be far from at ease when they are surprised in a tree. In such a case they will, after a moment devoted to satisfying their curiosity climb down promptly and move off through the undergrowth.

They may at times remain hidden among the thick vegetation at the base of some tree and utter their spasmodic bark of defiance with the object of deterring the intruder from further interference.

On one occasion I spent the greater part of an afternoon in the

[1] It is known that the hand of the gorilla is relatively shorter and broader than in any of the other apes, the Orang-utan, or the Chimpanzee. It is the same also with regard to the feet, which are almost flat and not arched as in man, with the big toe widely separated from the other digits as in the other apes. The photograph of the dead male shows that the fingers are short, tapered, and thick at the base. In the foot, as the tracks of the gorilla on soft ground will show, the heel is distinctly in evidence. The digits of the animal's foot are somewhat webbed at the base, making the small toes appear short and stumpy.



No. 15. A Gorilla Shelter in the hollow base of a large tree.
(*See Explanation of Plates.*)



No. 16. A recently vacated Night Shelter of a family of Gorillas showing the excrements of the Apes (x) in the right foreground.
(*See Explanation of Plates.*)



No. 17. A Gorilla "Bed" or "Nest" formed in the crotch of a bifurcated tree on the western slopes of Mt. Karisimbi at an altitude of some 11,000 ft.

close vicinity of a troop of feeding gorillas, in the hope of being able to secure a snapshot. The troop, which may have consisted of a couple of dozen or more members, were busy feeding within the confines of a very dense bamboo clump. Beyond hearing the loud snapping or the splitting of stems at intervals, occasional grunts, or a bark, we saw nothing but a stray glimpse of a peeping head or a passing body. The flock, which we had disturbed earlier in the day, was well aware of our presence but appeared now to pay not the slightest heed to us. They pretended to be unaware of any scrutiny and went on with their feeding, freely and without a care.

It appears quite evident that they are incapable of swinging themselves from tree to tree as do the Orang-utans, for instance. This is not difficult to understand, if we consider their external anatomy. It is worth noting, however, that the younger gorillas are capable of moving over the tops of dense bamboo thickets, causing comparatively little damage to the trees, considering their weight and bulk. In such case, they can spread themselves out sometimes with their arms apart, and crawl, so to speak, over the bending clusters of bamboo tops, snapping an occasional weak stem by their weight. The heavier males content themselves with seeking their food at the base of the trees, causing at times a regular din by the intermittent snapping of bamboo stems. The noise created in a bamboo patch by a troop of a couple of dozen feeding gorillas is not unlike that caused by a few elephants feeding in similar forests. On the other hand, among open forest in the higher altitudes, I found the gorillas singularly quiet and almost silent, unless they happened to be suddenly startled at close range. They remain quite silent throughout the night. A bamboo patch evacuated by a large flock of about a couple of dozen individuals bears ample testimony to the strength of which these animals are possessed, especially the old males, not only in the shape of broken bamboos some two and a half to three inches thick, but also of split bamboo stems deliberately twisted.

Among the forests of the higher regions, the gorilla may show a certain slowness, amounting almost to clumsiness, when they proceed on all fours along the overhanging or slanting branches of the Hagenia trees. This is readily understood if we consider the animal's configuration, and bear in mind the fact that the abdomen, especially in large individuals of advanced age, protrudes considerably, and gives a markedly pot-bellied appearance. The great weight of these heavy apes must also be taken into account.

Sleeping-places, Food and Enemies

Sleeping-places are commonly met with, and gorilla tracks are plentiful in certain localities. These apes move about a good deal and are constantly changing their feeding grounds. Their unsheltered resting-places are made of twigs and leaves heaped up a few inches from the ground, and generally bear the deep impression of their posteriors, as they squat on these 'ground-nests'. The young ones, as the traces show, huddle at night round their parents. It is not infrequent to see these nests fouled, and their vacated sleeping-places are often littered with dung. Their proper night-

quarters are mostly sheltered, and the following photographs will give an excellent idea of these retreats. The shelters are also sometimes occupied in the day time at intervals during heavy thunderstorms. The sleeping-places are, as a rule, not used on two nights in succession. The gorillas of these regions appear to be continually on the move from day to day, and seem to favour certain surroundings. This is a curious fact as there cannot be any question of scarcity, nor any marked difference in the food on the slopes, or ridges, in whichever direction they happen to turn. The shelters have often the appearance of a natural wigwam formed at the bifurcated or hollow base of some old Hagenia tree, with low and massive overhanging branch; they are curtained with a profusion of luxuriant vines and climbers. One of the photographs shows the nature of this creeper-vegetation round a newly-vacated gorilla night-shelter. In one corner may be noticed the excrement (marked with a cross) of the departed occupants, reminiscent of the dung of a horse. This was a snug and spacious retreat, which could have offered a comfortable rain-shelter for some half-a-dozen men. In some cases, the space is just enough to accommodate one large male: here the old man gorilla squats on his 'throne' apart from his family, surrounded by a drapery of creepers, which offers effective protection against wind and rain. The old animal is, moreover, enabled to peer from his eminence over the immediately surrounding undergrowth, as the shelters are often situated on the ridges or slopes.

Whereas the adult male gorilla seems to prefer the ground seats, it not infrequently happens that the younger members of a flock occupy small platforms, from four to six feet above ground level: such little platforms, which resemble nests after they have been occupied, are usually roughly built in the crotch of some large Hagenia tree.

The food of these animals consists mainly of tender bamboo shoots, sorrels, hemlocks, etc., and especially the pith of the parsley-like plants already referred to as the wild chervil. Berries are also eaten, and one finds, in addition, the remains of stalks of the taller plants from which the bark has been neatly peeled off and chewed.

As regards enemies of the gorilla, it may safely be accepted that no herbivorous forest animal would feel inclined deliberately to disturb a troop of gorillas, or even to remain for any length of time in their immediate vicinity. On the other hand, I have reason to believe, from the presence of leopards prowling on the skirts of a party of gorillas that, as has been already mentioned, these wily animals, with the patience and cunning characteristic of such prowlers, prey upon an occasional young gorilla. The gorillas of these forests cannot be regarded as particularly wary. The adult male gorillas are doubtless free from any kind of persecution by beasts of prey, and therefore more unwary. The young gorillas appear ignorant of their enemies; nevertheless they do not stray far from their parents.

Apart from the strenuous exercise with which the stalking of these great apes is invariably associated in a mountainous country



No. 18. Dead Leopard on the branch of a large *Hagenia* tree, showing a vacated Gorilla Shelter below.

covered with luxuriant vegetation, where, moreover, the atmosphere is mist-laden and rarified, the shooting of these animals can present no difficulty to the determined hunter. Few Europeans, however, would feel inclined to take the life from these normally harmless creatures, unless they were wanted for a definite purpose. The gorilla is, in these regions, by no means as rare as he has been supposed to be. The difficulty of obtaining photographs does not lie so much in actually surprising the animal in his mountain home as in finding circumstances which will allow a snapshot to be taken with a reasonable hope of success. The securing of a really effective picture remains at all times largely a matter of luck, although, of course, the greater the patience and determination exercised the greater the chance of success.

Note on the Gait of the Gorilla

As to the gait of the gorilla it is clear that in the wild state but few opportunities are obtainable for observation, owing to the difficult nature of the forest undergrowth.

Although rarely, they may yet at times expose themselves almost completely when they happen to move across the trampled vegetation of their feeding tracks. Much can be learned from the animals' spoor on the damp and soft humus soil.

In captivity the animal shows quite clearly the nature of its gait, as may be seen by watching the young West African specimen which was for a time at Regent's Park. It was found to exhibit three distinct gaits, namely: The walk on all fours, the upright walk, and the run.

In the first instance there is nothing unusual about the motions of their limbs as they are identical with those of a baboon moving on all fours. The application of the extremities of its limbs to the ground is, however, entirely different, since the gorilla, like the Orang-utan and Chimpanzee, does not place the palms, but the knuckles of the flexed hand on the ground. In the case of the feet, it walks on the outer margin of the sole and heel with the toes somewhat bent downwards.

Their walk in the upright attitude, in contradistinction to that on all fours, is in appearance not unlike the toddling gait of a pronouncedly bandy-legged child.

Their accelerated mode of progression, or run on all fours resolves itself into the following impacts, namely: right knuckles—left knuckles—margin of right foot pad—margin of left food pad. In fact, the impacts themselves succeed one another in much the same way as in the canter of a four-footed animal, i.e., a transverse motion. The arms of the gorilla being very long in proportion to its bowed legs, the body naturally slopes at an angle towards its posteriors, and consequently causes the head to remain more elevated than in the baboon, for instance. The forward progression of the body, in the run, is accompanied by a slight side swing, an almost imperceptible side twist, of the animal's hind quarters.

Although the great toe of the gorilla is widely separated from the smaller digits, and forms with the latter a prehensile foot, it will be noticed in the young specimen at the Zoo that in its erect, as

well as in its stooping gait the great toe is usually held in close to the other digits. The large toe is held somewhat flexed, with the ball turned inwards and slightly downward. The creature walks normally on the outside margin of its heel and foot pad and holds the sole slightly at a slant. Its tracks on the soft mud usually show a deep impression of the outer edge of the foot and heel, and a faint impression of the small toes.

FULLER EXPLANATION OF PLATES

No. 1

Mount Mgahinga (11,400 ft.) with Mount Muhavura (13,547 ft.) in background. Taken in the evening from the slopes of Mount Sabinio.

No. 2

Mr. James Hugh Barnes, Mr. Maxwell's companion, with the porters. The outline of the preciptous peaks of Sabinio, seen in the background, bears resemblance to that of a molar tooth. This photograph was taken from a point on the saddle between Sabinio and Mount Mgahinga, at an altitude of 8,600 feet. It is remarkable with what scanty clothing these natives can face the raw cold on these heights. The steep slopes of Sabinio are covered with bamboo to a height of nearly 9,000 feet from which altitude commences the subalpine vegetation, first the arboreal heaths and finally the alpine groundsels with lobelias among the Alchemilla meadows.

No. 3

Panoramic view of Mount Mikeno (14,385 ft.) and Mount Karisimbi on the left (14,633 ft.), with the summit of the latter hidden in the clouds. This photograph was taken from a spot, to the east of Mikeno, with an altitude of 8,400 feet. On these two mountains the bamboo forests cease at a height of some 9,000 ft. and the vegetation from this height to about 12,000 ft. consists mainly of Hagenia trees with widely spreading branches, amidst a meadow undergrowth of chervil-like plants, nettles and other harbaceous growths, interspersed with tall giant lobelias. Above 12,000 ft., the arboreal heaths, giant groundsels and lobelias, among other alpine plants, make their appearance more common, and take the place of the Hagenias; a soft carpet of Alchemillas and different kinds of drab moss constitutes the ground vegetation. The three zones of flora can roughly be distinguished on the photograph. Traces of gorillas are met with from an altitude of 7,000 ft. and are fairly common in places up to 12,000 feet. They become scarce above this height.

No. 4

Panoramic view of Mount Sabinio, taken from an altitude of some 8,000 ft. above sea level, looking up into the north eastern gorge. Apart from numerous glens and corries, the slopes of Sabinio are intersected by no less than three immense gorges, one on the north-east, another on the south-east and a third on the north-western slope.

The white patch of smoke, on the right-hand side of the throat of the gorge shown about half-way up the mountain, indicates Mr. Maxwell's night camp, at an altitude over 9,000 ft.

No. 5

Hagenia trees among the carpet of a soft undergrowth consisting of nettles, docks, sorrels, hemlocks and mainly of a plant resembling a wild chervil, which is a favourite food of the gorilla. This scene represents a typical forest of Mikeno at an altitude of 11,000 ft. and thereabouts. The height of the undergrowth is indicated by the native standing on the right-hand side of the foreground.

No. 6

Another forest scene on the same altitude and showing a portion frequented by gorillas.

No. 7

A forest of *Hagenia abyssinica* with a view on the western slope of Mikeno, looking up towards its summit. This view was taken at an altitude of a little over 9,000 feet. The poker-like tops of a few giant lobelias are visible in the foreground.

No. 8

Arboreal Heath (*Erica arborea*) and Senecio, or giant groundsels (*Senecio johnstoni*). Note their respective heights by comparison with the figure below the trees.

No. 9.

The summit of Mt. Mikeno, height 14,385 ft. Taken from a point over 12,000 ft. in altitude to the south-east of this peak. The peak is occasionally covered with snow at the summit and frequently enveloped in clouds. In the foreground can be seen the crowns of the last Hagenia trees. Note the alpine vegetation on the slopes of the peak.

No. 10.

A startled female gorilla making off with her young on her back. Indistinctly, on the right, about halfway up the slope may be seen a sub-adult Gorilla showing the upper part of its body above the undergrowth. This photograph was taken on the Western slope of Mt. Karisimbi, at an altitude of some 11,000 ft.

No. 11.

An adult male gorilla, shot by the late Commandant Elias Arrhenius for the Swedish Museum of Natural Science.

No. 12.

A pair of female gorillas, secured by the late Commandant Arrhenius and destined for the Swedish Museum of Natural Science. The specimens were secured on Mount Mikeno.

No. 13.

Four captured young gorillas, of which two were destined for the Antwerp Zoological Gardens but only one of the two reached Antwerp. The remaining two appear, from accounts given to me, to have died locally.

No. 14.

One of the four young gorillas with its guardian.

No. 15.

A gorilla shelter in the hollow base, and among the bifurcated roots of a large tree. It forms a snug and spacious shelter for several people. Note the vegetation round the roots and the luxuriant growth of the mosses.

No. 16.

A recently vacated night shelter of a family of gorillas, at the base of an old Hagenia tree. Note the nature of the vegetation at this altitude (approximately 11,000 ft.) and the excrements of these apes on the foreground, to the right of the trellis of climbers in the centre.

No. 17.

A gorilla 'Bed' or 'Nest' on the western slopes of Karisimbi, formed in the crotch of a bifurcated tree. The 'Nest' is about four feet from the ground. As their traces point out the adults prefer their resting places on the ground. The young ones occasionally occupy such elevated little platforms, a few feet from the ground. This photograph was taken at an altitude of some 11,000 feet.

No. 18.

Dead leopard on the branch of a large Hagenia tree. Below the branch is a vacated gorilla shelter.

INDIAN DRAGONFLIES

BY

F.C. FRASER, LT.-COL., I.M.S., F.E.S.

Part XXIX

(*With three plates.*)

(*Continued from page 319 of this Volume*)

Genus—RHINOCYPHA Ramb. (*cont.*)

Group—*perforata.*

Rhinocypha whiteheadi, Kirby, Ann. Mag. Nat. Hist, (7), vol. v, p. 536, pl. xii, fig. 4 (1894) ; Martin, Mission Pavie, Nevrop. (sep.) p. 17 ; Laid. Rec. Ind. Mus., vol. xiii, pp. 38 and 39, (1917) ; Fras. Mem-Pusa. (Ent. Ser.), vol. vii. No. 7, pl. viii, fig. 4 (1922)

Male. Abdomen 17 mm. Hindwing 21 mm.

Head : labium and labrum and rest of head velvety black marked with blue as follows :—a reniform or oval spot on the outer side of each hinder ocellus, a smaller postocular spot behind it and a medial linear occipital spot behind them.

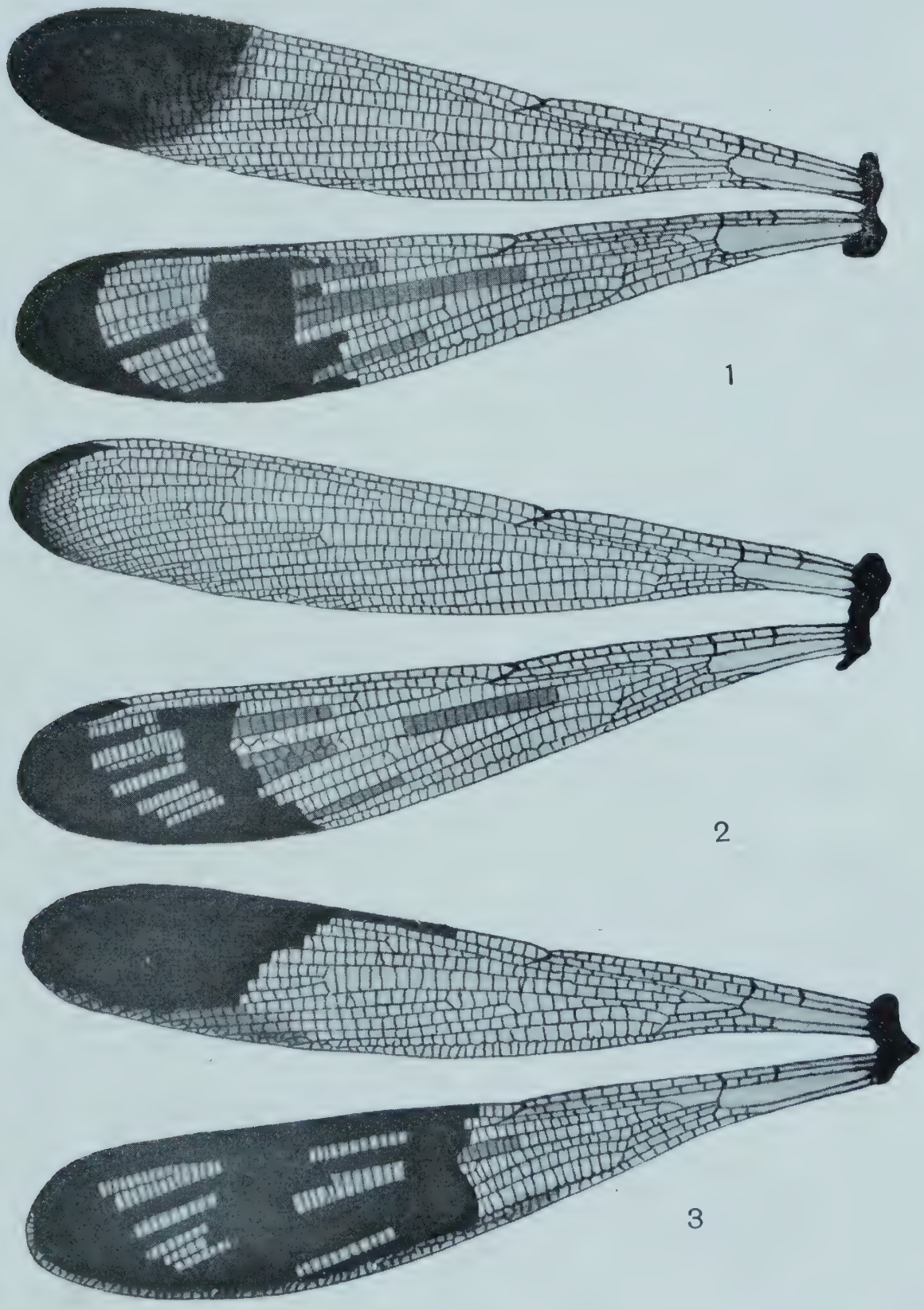
Prothorax black marked on each side with a rounded pale blue spot, and a large blue spot on the dorsum of posterior lobe and hinder portion of middle lobe, shaped like an arrow-head.

Thorax velvety black with a dark violet lustre, marked with azure blue and chrome-yellow as follows :—the mesothoracic triangle pale blue, extending considerably less than half-way up the dorsum of thorax, and very broad at base, far more so than in others of the genus ; an antehumeral stripe consisting of a small isolated spot above and a narrow curved stripe on the lower half of dorsum ; a fine posthumeral stripe closely apposed to the humeral suture, broken above to leave a small isolated spot, behind which is another elongate larger spot, all blue A broad interrupted stripe on lower part of sides, yellow, but the portion on the metepimeron, blue anteriorly. Pruinosed white beneath.

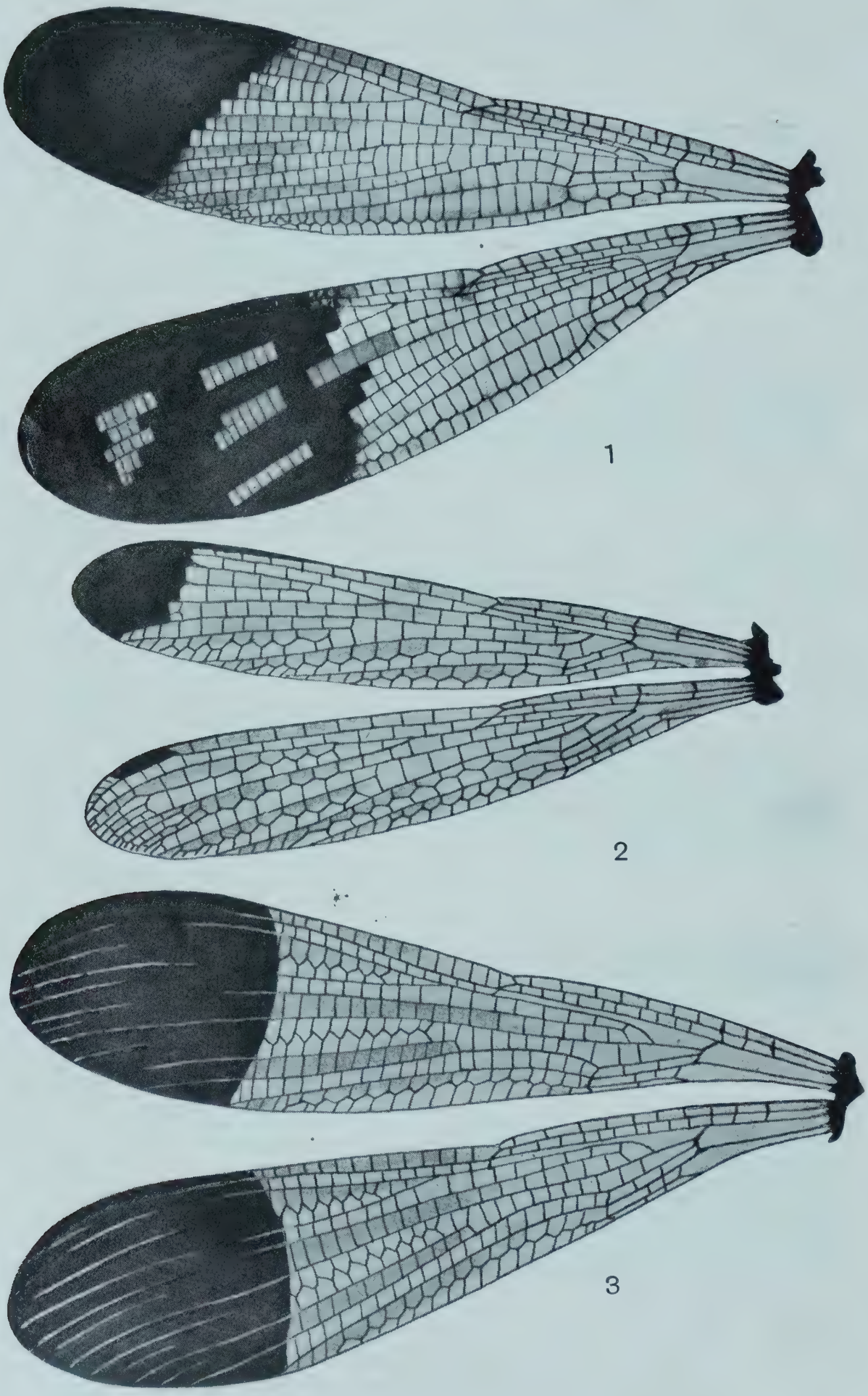
Legs black, the two hinder pairs of tibiæ, and the femora pruinosed white.

Wings hyaline palely tinted with yellow at the bases, opaque blackish brown apically, the hindwing marked on this part with three rows of vitreous spots. Forewings with the apical portion opaque blackish brown as far inwards as, rather more than half-way from apex to node, extending nearer the node along costal border of wing, the inner border of the area serrate and running obliquely backward and outwards ; pterostigma black, the cells immediately beneath it hyaline. Hindwing with opaque area darker and extending inwards for about three-fourths the distance between apex and node, its inner border very irregular, indented and serrate. The vitreous spots a beautiful violet from whatever angle viewed. The apical spot single, 4 cell-rows deep by 6 cells wide, irregularly shaped, situated 3 cell-rows behind pterostigma, which is black; the middle row of spots 3 in number, all in alignment and of about equal length, about 10 cells wide, the costal spot lying between *IRii* and *Riii*, the mid spot between *IRiii* and *Riv* + *v*, the hinder spot between *Cuii* and *IA* ; the proximal spot single, short, only 5 cells long, lying between *IRii* and *Riv* + *v*, projecting slightly into the opaque area. All wings with 14 to 15 antenodal nervures ; discoidal cell traversed 3 times in the forewing, 4 times in the hind ; wings petiolated to level of 2nd *an* ; 21 to 26 postnodals. Wings of approximately the same shape and length, long and narrow, the hind slightly broader than the fore.

Abdomen black marked with azure blue as follows :—segments 1 to 4 with lateral rounded spot at apical end of segments, growing successively smaller



1. WINGS OF *Rhinocypha bisignata*, Selys, male.
2. WINGS OF *Rhinocypha biforata delimbata*, Selys, male.
3. WINGS OF *Rhinocypha perforata perforata*, Perch, male.



1. WINGS OF *Rhinocypha whiteheadi*, Kirby, male.
2. WINGS OF *Micromerus lineatus*, Burn., male.
3. WINGS OF *Calocypha laidlawi* (Fras), male.

from 1 to 4, segment 1 has also the apical border narrowly lined with blue, and there is a short ventro-lateral stripe on segments 2 and 3. Anal appendages shaped as for genus ; inferior appendages with a series of small robust spines on upper surface.

Female. Unknown.

Distribution. Cachar, Assam. Very local but apparently not uncommon where found, to judge by the numbers taken by Mr. Antrim. Martin reports it from Tonkin, but I was unable to find any specimens in his collection in the Paris Museum, and infer that he has mistaken a race of *perforata* for this insect. There is a single male from Sibsagar, Assam, in the Indian Museum collection. Although belonging to group *perforata*, it is not very closely related to *perforata* itself, and cannot even be considered as a subspecies of that insect as has been suggested. Its wings are not only broader than *perforata* but are distinctly rounded at the apices. It ought not to be difficult to discover the female of this beautiful insect.

Rhinocypha perforata perforata Percheron. (*Agrion perforatus*), Gen. Ins. Neur. t, 2 (1835) ; Ramb. Ins. Nevrop., p. 235 (1842) ; Selys, Syn. Cal., p. 63 (1853) ; Id. Mon. Cal., p. 219 (1854) ; Id. Bull. Acad. Belg. (2), vol. xxxv, p. 487 (1873) ; Walk. (*Libellago perforata*), List. Neur. Ins. B.M., vol. iv, p. 647, No. 7 (1853) ; Kirby, Cat. Odon., p. 114 (1890) ; Mart. Mission Pavie, Nevrop. (sep.) p. 17 (1912) ; Will. Proc. U.S. Nat. Mus., vol. xxvii, p. 174 (1904) ; Krug. (*R. apicalis*) Stett. Ent. Zeit. p. 79 (1898) ; Laid. (*R. inas*) Proc. Zool. Soc., Lond., pp. 88–90, pl. vi, fig. 6 (1902) ; Id. (*R. apicalis*) Fascic. Malayensis (Zool), part 1, p. 196 ; Id. Rec. Ind. Mus., vol. xiii, pp. 38, 39, (1917) ; Fras. Mem. Pusa (Ent. series), vol. vii, pl. viii, fig. 3 (1922).

Rhinocypha perforata perforata is not found within Indian limits, but is represented by its subspecies or races *limbata* and *beatifica* described below. The type comes from Cochin China, and cotypes exist in the Maclachlan collection from the Isle of Hainan, China, collected by Swinhoe. It differs from *limbata* by not having the border of the apex of hindwing vitrefied hyaline and by the reduced opaque area in both fore and hindwings. In the forewing this area occupies a little more than the apical fourth, but in the hindwing extends to within four cells of the node. In *limbata* this area extends nearly up to the node in the forewings, but is variable in the hind, usually to about the same distance from the node, whereas in *beatifica* it extends right up to the node. Type in Paris Museum.

(In referring to my paper in the Memoirs of Pusa cited above, I note that the figures have been wrongly numbered in the plate. Figure 4 is really *R. whiteheadi*, and figure 3 should be *R. perforata limbata*.)

Rhinocypha perforata limbata, Selys, Bull. Acad. Belg. (2), vol. xlvii. p. 392, (1879) ; Kirby, Cat. Odon. p. 114 (1890) ; Laid. Rec. Ind. Mus., vol. xiii, p. 38 (1917).

Male. Abdomen 16–18 mm. Hindwing 25 mm.

Head : labium dirty white, the apices of lobes black ; labrum and rest of head velvety black with a small rounded spot on the outer side of each posterior ocellus, a larger rounded postocular spot and a linear medial spot on the occiput, all bluish.

Prothorax black with the greater part of the posterior lobe rose pink or lilaceous, and a large blue spot on either side of the middle lobe.

Thorax velvety black, the mesothoracic triangle extending rather more than one-third up the dorsum, lilaceous in colour. On the outer side of this triangle, and slightly longer than it, a large subtriangular azure blue spot with its hinder border meeting the anterior part of the humeral suture. Above this spot a small triangular upper humeral spot also blue, whilst laterally the greater part of the sides are of the same colour, viz., nearly the whole of the mesopimeron, the upper two-thirds of the metepimeron and a narrow prolongation along the hinder border of the humeral suture going as far as the root of forewings. Beneath thorax 2–4 yellow spots which may be somewhat obscured by pruinescence. In the Siamese and Annamese forms, there are only two small rounded spots at the hinder part of thorax, whereas in specimens from Assam, there are two additional larger oval spots in line with and in front of these,

Legs black, the flexor surfaces of the two hind pair of femora and tibiæ pruinosed white or creamy white.

Wings very long and very narrow, of equal breadth, hyaline in the basal portions where they are palely tinted with yellow; opaque blackish brown in the apical portions, marked with two series of vitreous spots in the hindwings. Forewings with the outer third only opaque, this area stopping short of the hinder border of wing, with a serrate border proximad and prolonged inwards along the costal border between the costa and *Ri*, to within 2–4 cells of the node; the hyaline border of wing posterior to the opaque area vitreous with bluish, violaceous or green reflex which may extend as far as the extreme apex of wing. Pterostigma black; 15 antenodal nervures, 24 postnodals; discoidal cell traversed twice only; petiolation ends at level of 2nd antenodal nervure. Hindwing with opaque area extending inwards to within 1 to 4 cells of node, the proximal border of this area ragged and indented deeply by a vitreous spot 8 or 9 cells long, between *IRiii* and *Riv* + *v*. The hinder border of wing narrowly hyaline and vitreous, finely reticulated and extending round apices of wing as far as pterostigma. The apical series of vitreous spots very variable, usually composed of 3 linear spots which decrease in length from costa to hinder border of wing and which slightly overlap the level of inner end of pterostigma. The costal spot 11 to 16 cells long, lying, between *IRii* and *Riii*; the hinder spot 3 cell-rows deep by 4 to 8 cells long, lying between *IRiii* and *Riv* + *v*, whilst the middle spot, which is 2 to 3 cell-rows deep by 9 to 10 cells long, lies midway between the two others banded by short intercalated sectors; the inner series lying rather nearer the node than pterostigma, composed of 3 spots, a costal spot 1 cell-row wide by 10 cells long, lying between *IRii* and *Riii*, a medial spot 2 cell-rows wide by 10 to 15 cells long between *IRiii* and *Riv* + *v*, and a hinder spot 1 cell row wide by 9 to 12 cells long between *MA* and *Cuii*. All these vitreous spots and areas glowing emerald green or opalescent according to the angle from which viewed; 28 postnodal nervures, 14 to 15 antenodals; discoidal cell traversed 3 to 4 times; petiolation the same as for forewing; pterostigma black.

Abdomen black marked laterally with azure blue as follows:—segment 1 with a large cuneiform spot on each side, 2 with a bilobed, longitudinal spot extending from near the base to apical border, 3 to 4 with long wedge-shaped spots with base of wedge at apical border of segments, segments 5 to 9 with short triangular apical spots, that on 9 being very reduced.

Anal appendages black, superiors slender, cylindrical, semi-circular, a little broadened at apex which is curved strongly in. Inferiors half the length of superiors, moderately separated, bluntly pointed, a little denticulated at apex. The superiors minutely spined on the outer sides near apex.

Female. Abdomen 18 mm. Hindwing 26 mm.

Differs from male by having the wings entirely hyaline, tinted palely with greenish yellow; pterostigma blackish brown, its outer half yellow at the centre, especially in the hindwings; 13 to 15 antenodal nervures in forewings, 26 to 30 postnodals.

Head similar to that of male with the addition of a large spot of yellow on upper surface of epistome and two smaller ones behind it. The spots on vertex and occiput also yellow, body-markings same as for male but yellow instead of blue, the mesothoracic triangle finely outlined in yellow, its centre black.

Legs black, tibiæ and femora not pruinosed. Abdomen black with yellow markings as for male, but with additional ventro-lateral stripes on segments 2 to 5. Vulvar scale as for genus.

Distribution. *Limbata* extends from Annam, through Siam to Burma and Assam. The type in the Selysian collection, is from East Burma. The type of *perforata perforata* is from Cochin China and is distinguished from *limbata* by the total absence of the hyaline and vitreous border of the hindwing, the opaque area here coming right down to the border of wing, at least along the extreme apex. The abdominal markings, said by Selys to be more restricted in *limbata*, are not found to be so when a series of specimens are examined. In the forewing at least, the opaque area is greatly reduced as compared to *limbata* or *beatifica*.

Rhinocypha perforata beatifica, Fras. Rec. Ind. Mus., vol. xxix, pp. 86–87 (1927). Similar in size and markings to *limbata*, from which it differs by the greater extent of the opaque area in all wings, extending in the fore and hind right up

to the level of node. This is especially noticed in the forewings, where not only does the costal streak extend to node, but also the body of the area, the serrated border running from the node and extending as far as the apex of wing, leaving a rather broader area of hyaline border than is found in *limbata*. In the hindwing, the hyaline border broadens out at apex of wing, extending right up to, or even overlapping, the outer end of pterostigma. This latter has a narrow bluish centre in the hindwing along its outer half, and that of forewing is pale for the same extent. In the outer series of vitreous spots, the middle spot is 2 cell-rows deep and is fused completely with the costal spot, so that in reality there are only two spots in this series.

Distribution. Naga Hills, Assam, from April to June. Type in the Fraser collection. *Beatifica* differs from *limbata* to about the same extent as does the latter from true *perforata*, so that it is quite possible, that given sufficient material, it might be possible to construct a series showing a gradual merging of one into the others. For the present I consider it better to consider the *perforata* series as one species with two subspecies.

Rhinocypha biforata biforata, Selys, Bull. Acad. Belg. (2) vol. vii, p. 446 (1859) ; Id. ibid. (2), xlvii, p. 392 (1879) (*R. biforata*, race *delimbata*) ; Kirby, Cat. Odon. p. 113, (1890) ; Laid. Proc. Zool. Soc. Lond. (1), p. 88. (1902) ; Will. Proc. U. S. Nat. Mus., vol. xxviii, pp. 173 and 179, fig. 12, (1904) ; Laid. Rec. Ind. Mus., vol. xiii, pp. 37 and 38, (1917) ; Fras. (*R. beesoni*) Mem. of Pusa. (Ent. Ser.), vol. vii, No. 7, pp. 61 to 63, (1922).

Male. Abdomen 26 mm. Hindwing 23 mm.

The species is not found within Indian limits but is represented by its subspecies—*biforata delimbata* Selys, *biforata beesoni*, Fras, and *biforata abbreviata* subsp. nov. From all these *biforata* is easily distinguished by the greater extent of the opaque area in the hindwings, where it extends right up to the node or a little beyond it. The vitreous spots tend to be longer in *biforata* and the reticulation somewhat closer. *R. beesoni* falls closer to the parent species but curiously enough, is separated from it geographically by the intervention of the other two subspecies.

Rhinocypha biforata delimbata, Selys, Bull. Acad Belg. (2), vol. xlvii, p. 392 (1879) ; Kirby, Cat. Odon. p. 113 (1890) ; Will. Proc. U. S. Nat. Hist. Mus., vol. xxviii, pp. 173 and 179, fig. 12 (1904) ; Laid. Rec. Ind. Mus., vol. xiii, pp. 37 and 38 (1917).

Male. Abdomen 19–20 mm. Hindwing 23–26 mm.

Head velvety black marked with five bright ochreous spots, one-rounded or oval on the outer side of each posterior ocellus, a round postocular spot on each side and a medial oval occipital spot. Labium white, the lobes tipped with black.

Prothorax black, the posterior lobe finely bordered with yellow and with a large rosepink spot in its middle. A large bluish spot on each side near the trochanters and a similar subdorsal spot on each side of middle lobe.

Thorax velvety black marked as follows :—the mesothoracic triangle rosepink or lilaceous, extending less than half-way up the dorsum of thorax but continued as a fine line of the same colour along the middorsal carina as far as the antealar sinus. On each side of the mesothoracic triangle, a large irregularly oval spot of the same colour, much larger than the triangle itself, a small upper antehumeral spot, a broadish stripe behind the upper two-thirds of the humeral suture, the greater part of the mesopimeron, and metepimeron, azure blue. The hinder lateral suture, the lower part of the metepimeron, and a quadrate area on the upper anterior part of mesopimeron all black, the latter area bearing a small isolated blue spot. Beneath 6 large yellow spots separated by black sutures and framed narrowly in black.

Legs black, the two hinder pairs of tibiæ pulverulent white, the same two pairs of femora pulverulent yellow on the flexor surfaces.

Wings hyaline, the greater part enfumed and tinted with yellow, which is most intense near the bases. Forewings with apices tipped with blackish brown, this marking gradually shading off into the hyaline area at outer end of pterostigma (in *biforata biforata* this area begins well proximal of the pterostigma and covers about the outer fifth of the wing) ; discoidal cell traversed 3 times ; 14–16 antenodal nervures, 27–32 postnodals ; petiolation ends at the level of the

2nd antenodal nervure. Hindwings with about the apical fourth opaque blackish brown (the apical third or more in *biforata biforata*), this area marked with a series of four linear vitreous spots, very irregular, each varying in length, and the costal three often linked up by one or more connecting cells, the inner level of the spots forming a concavity towards apex of wing, as does also the inner border of the opaque area, which extends slightly more basad along hinder border of wing. Just proximal of the opaque area (projecting into it in *biforata biforata*) a second row of vitreous spots.

The costal one of these spots lying slightly nearer the node than pterostigma, composed of one row of cells, about 12 in number, lying between *IRii* and *Riii*, the second spot shorter, lying more distad, 2 cell-rows deep by 8 or 9 cells long, lying between *Riv+v* and *Riii*, the hinder spot at the same level as the costal, 9 cells long by 1 row wide, lying between *MA* and *Cuii*. In the same space as the medial spot of this series, but lying behind level of node, another vitreous spot 1 row wide by 11–18 cells long. Pterostigma black ; 15–16 antenodal nervures, 26 postnodals ; discoidal cell traversed 3 times.

Abdomen black marked with azure blue as follows :—a large triangular spot on each side of segment 1, a midsubdorsal and an apicolateral spot on each side of segment 2, as well as a ventro-lateral stripe below them ; similar spots and stripes, but longer, on segments 3 to 5 ; segments 6 and 7 with the ventro-lateral stripe only.

Anal appendages black, shaped as for genus.

Female. Abdomen 15–16 mm. Hindwing 23 mm.

Head black with the same markings as for male, but in addition, the bases of mandibles, the basal segments of antennæ, two large spots on frons and two minute linear spots in front and to the outer side of the anterior ocellus all yellow.

Prothorax black with the following yellow markings :—the hinder border of posterior lobe outwardly finely yellow, a narrow longitudinal medial line, often broken into minute points on the dorsum of same lobe, a geminate point at the anterior end of this on the medial lobe, a largish triangular spot on each side of midlobe and a rounded spot on each side of the anterior end.

Thorax black, marked with blue and yellow as follows :—the mesothoracic triangle finely mapped out in yellow, its centre black, a fine antehumeral line incomplete above and strongly hooked outwards and backward in front, a fine incomplete humeral line, all yellow. The sides similar to the male, blue.

Legs black, not pruinosed, the flexor surfaces of the hinder pairs of femora yellow.

Abdomen black marked exactly as for male. Vulvar scale and anal appendages as for genus.

Distribution. Burmah and Assam, common in parts of the former but apparently rare or local in the latter. I have specimens from Mergui, Lower Burma collected in November, and from Maymyo, Upper Burma, collected in July, the latter specimens by Col. F. Wall. It appears to be the commonest *Rhinocypa* in the Maymyo district.

The measurements differ widely from those given by Selys for *biforata*, but it is obvious that these are incorrect, at least those for the abdomen. The Maymyo specimens are very constant in their markings, especially with regard to the extent of the opaque areas of wings, so that I think *delimbata* should at least rank as a subspecies.

Rhinocypha biforata abbreviata subsp. nov.

In a male specimen from Assam, now in my own collection, and which I have named *abbreviata*, I note the following differences :—

The mesothoracic triangle is considerably smaller than in *delimbata* and the carina above it is unmarked ; the antehumeral spot is absent ; the forewings have only the extreme tips opaque and the nodal index is considerably lower, (12 antenodal nervures and 21 postnodals) ; the outer series of spots are discrete and all are much shorter than for type (12 to 13 cells for costal spot in *biforata*, only 6 in *abbreviata*, 18 cells in the second spot, only 14 in *abbreviata*, etc.).

The middle series of spots show the same difference, being only 4 to 5 cells in length and falling well short of the opaque area, although in the hindwing, this area is as extensive as in *biforata biforata*. Finally the proximal spot is only 8 cells in length. The nodal index of hindwing lower, 11 antenodals and 23 postnodals.

Abdomen with markings present on the first five segments only :—a large triangular blue spot on the sides of segment 1, an apical rounded spot, a short mid-lateral stripe and a ventro-lateral stripe on segment 2, segments 3 to 5 as for 2 but the medial stripes absent and the other markings much reduced.

The small size of this insect, the abbreviated vitreous markings, and the reduced abdominal markings are, I think, sufficient to form a well-defined subspecies, bearing the same relation to *biforata* as does *trimaculata* to *ignipennis*.

Rhinocypha biforata beesoni, Fras, Mem. Dept. Agricult. Ind. (Ent. ser.) vol. vii, No. 7, pp. 61 and 62 (1922).

Male. Abdomen 18 mm. Hindwing 25 mm.

R. beesoni shares the characters of *biforata* and *delimbata*, in that the apical opaque area of the forewings is as extensive as in *biforata*, and the same area in the hindwings is as reduced as in—*delimbata*. In—the forewing the opaque area extends 2 to 3 cells proximal of inner end of pterostigma, the inner margin somewhat irregular, bevelled outwardly from costa posteriorwards and prolonged slightly along the costa as far as half-way between pterostigma and node between the costal and radial nervures. There is also a slight prolongation along hinder margin of wing. In the hind wing the opaque area covers nearly the outer third of wing and the middle series of spots extends right up to it or even invades it for a short distance. The length of these spots is slightly greater than in *abbreviata*, but decidedly less than in *biforata* or *delimbata*. The vitreous spots in all these subspecies have a metallic green or coppery reflex in the opaque areas, violaceous in the hyaline area.

The discoidal cells are traversed 3 and 4 times respectively, the forewing has 14-15 antenodals, and 22–25 postnodals. The body markings are similar to those of *delimbata*.

Distribution. The type in the Forest Research Institute, Dehra Dun, comes from Lachiwala in that district, and was collected in the month of November. I have also seen two pairs in the Pusa collection which were collected at Mergui, Lower Burma, during June. There are no records of its having been taken in the vast stretch of country separating these two localities and it may be that some error in tabulating has crept in, for Mr. C. F. Beeson collected in Lower Burma as well as around Dehra Dun. It is easily distinguished from *delimbata* and *abbreviata* by the extent of the apical marking of forewing, and from *biforata* by the much reduced opaque area in hindwing.

Rhinocypha bisignata, Selys. Syn Calop p 62. (1853); Id. Mon. Calop. p. 214, (1855) ; Walk. (*Libellago bisignata*) List. Neur. B. M. vol. iv. p. 648. No. 9, (1853) ; Kirby, Cat, Odon. p. 113 (1890); Laid. Rec. Ind. Mus. vol. xiii, p. 38, (1917) ; Fras. Mem. Pusa. Dept. Agric. (Ent. series) vol. vii, No. 8, pp. 80 and 81, pl. x (1922) ; Id. Rec. Ind. Mus. vol xxvi, p. 483 (1924).

Male. Abdomen 20 mm. Hindwing 24–26 mm.

Head. Eyes brown, rest of head, including lips velvety black. A small spot external to each posterior ocellus, a similar postocular spot on each side and an occasional occipital spot all bright ochreous.

Prothorax black with a large yellow spot on each side of middle lobe, a similar spot on the outer ends of posterior lobe and a large rose-pink spot covering the greater part of dorsum of same lobe.

Thorax black marked as follows:—the mesothoracic triangle rose-pink, extending for more than one-third, but for less than half-way up dorsum of thorax ; a large oval spot of the same colour, pointed at both ends, bluntly so anteriorly, lying between the humeral suture and mesothoracic triangle, but well separated from latter, and of twice its length ; a small upper yellow antehumeral spot, a narrow yellow stripe bordering the upper half of humeral suture behind; a broad very broken stripe on hinder half of mesopimeron and the whole centre of metepimeron golden yellow. Beneath three pairs of yellow spots, the hind the larger, the middle pair obscured. Legs black, the two hinder pairs of tibiæ and femora pruinosed white on flexor surfaces.

Wings long and narrow as in *biforata*, the hind slightly broader than the fore, hyaline in the basal portions, where they are tinted with yellow, opaque blackish brown in the apical areas, the hind bearing here a large vitreous fuliginous spot. Forewings with the outer fourth or more opaque, this area

being briiliant coppery or with fiery reflex as in *ignipennis*, with its inner border prolonged slightly basad between costa and *Ri* and running obliquely out towards the hinder border of wing. Hindwing with the inner third opaque and marked with two series of vitreous spots which glow with a coppery reflex, or violaceous, the inner spot always the latter colour. The outer spot produced by a fusion of similar spots to those seen in *biforata*, but often completely or partially divided into two or more spots, lying between *Rii* or *MA* or *Riv+v*, and its outer border on a level with the middle of pterostigma. The inner series composed of 3 vitreous spots similar to those seen in *biforata* but the middle one usually prolonged inwards to fuse with the nodal spot seen in *biforata*. The first spot of this series one row deep by 8 cells long, lying between *IRiii* and *Riv+v*, the middle spot 20-22 cells long when fused with the nodal spot, otherwise only 10 cells long, lying between *IRiii* and *Riv+v*, the hinder spot 11–12 cells long, lying, between *MA* and *Cuii*. Pterostigma black in all wings ; nodal index 12–14 antenodals and 28–31 postnodals in the forewings, 12–14 antenodals and 22-28 postnodals in the hind ; discoidal cell traversed 2–3 times in forewings, 3–6 in the hind; petiolation begins slightly proximad of the 2nd antenodal.

Abdomen black marked with yellow as follows :—segment 1 with a sub-triangular lateral spot on each side ; segment 2 with a midlateral stripe, an apical spot and a ventro-lateral stripe ; 3 and 4 similar to 2, but the mid-lateral spot obsolete, whilst 5 has the apico-lateral spot only. All other segments unmarked.

Anal appendages as for genus, the inferiors minutely spined above.

Female. Abdomen 16 mm. Hindwing 22 mm.

(Although so common an insect, and known for so long a time, the female of this insect has hitherto escaped description).

Head. Labium bluish green tipped with black ; labrum black with a large oval or triangular yellow spot on each side ; cheeks broadly yellow, this colour continued up as a narrow bordering to eyes as far back as the level of the posterior ocellus, the basal segments of antennæ, a small triangular spot low down on sides of epistome, two large triangular spots on the upper surface of frons, two transversely oval spots just behind these lying in front and to outer side of anterior ocellus, all yellow ; a small rounded spot on the outer side of each posterior ocellus, a rounded postocular spot on each side and a mid-occipital spot, triangular in shape all bright ochreous.

Prothorax black with a large yellow spot on each side and the borders of the posterior lobe finely yellow laterally.

Thorax as for male but the large antehumeral spot replaced by a fine ante-humeral line incomplete above, whilst the mesothoracic triangle is black, finely outlined in yellow, as also the middorsal carina. Legs black, not pruinosed.

Wings entirely hyaline, tinted palely with yellow, the apices narrowly en-fumed ; pterostigma black with pale creamy centre ; discoidal cell traversed twice, or more rarely, thrice in all wings ; 12–14 antenodal nervures, 21–27 post-nodals in forewings, 19–24 in the hind.

Abdomen black marked with yellow as for male but rather more extensively, thus segments 3 to 5 are marked similarly to 2, and 6 and 7 similar, the remainder unmarked.

Anal appendages and vulvar scale similar to genus.

Distribution. This species is the sole representative of the genus in Southern and Peninsular India. It is a widely distributed insect, thus I have records of its capture in localities as wide apart as Cochin and the Central Provinces. It is common throughout the Palnai, Nilgiri and Shevaroy Hills in the far south, abundant in Coorg, less common at Khandala and Igatpuri on the ghats near Bombay, lastly it is widespread throughout the Agency Tracts and Jeypore on the East Coast. Its exact limits here are yet to be worked out but it probably stops short of Bengal. It is a submontane insect, living and breeding between 2,000 to 5,500 feet altitude Its larva was discovered in the Nilgiris and—was one of the first to be described of the genus. The females congregate on the bare twigs of neighbouring trees in great numbers and are very rarely seen pairing. Occasionally they may be seen ovipositing on a piece of dead twig floating in mid-stream. The males frequently disport in couples before the females, circling and sparring with one another, their white pruinosed legs glis-tening and thrust out like the arms of a wrestler seeking for an opening. Meanwhile their wings flash like living jewels of fire.



FIG. 1.



FIG. 2.

1 AND 2. TWO VIEWS OF THE CAUVERY RIVER NEAR FRASERPET, COORG, WHERE *Rhinocypha bisignata* AND *Micromerus lineatus* ABOUND. OTHER DRAGONFLIES TAKEN IN THESE SPOTS WERE *Chloroneura apicalis* AND *quadrimaculata Zygonyx isis, Macromia indica, Macromidia donaldi, Onychothemis testacea ceylanica,* ETC.

Genus CALOCYPHA, gen. nov.

Moderately small but robust insects with characters similar to those of *Rhinocypha*, differing mainly in details of venation and the greater petiolation of wings. Head, thorax, abdomen and legs similar to *Rhinocypha*. Wings equal in length, similar in shape, apices markedly rounded, reticulation more open than in *Rhinocypha*, hyaline with opaque apices; the arc very oblique, lying almost in the same line as the costal border of discoidal cell, the latter shorter than in most *Rhinocypha* and acutely pointed outwardly; petiolation beginning at or well distad of the inner end of discoidal cell; the nervure *ac* situated more basad than in *Rhinocypha*; anal appendages slenderer, the superiors twice the length of segment 10, narrow, cylindrical, curving in at apices which are bluntly pointed, furnished with a few hairs. Inferiors much shorter, half the length of superiors, broad at base, directed directly back and parallel to one another, furnished with a few minute spines on upper surface.

Female with apices of hindwings partially opaque, the venational details as for the male. Vulvar scale and anal appendages as for genus *Rhinocypha*.

Calocypha laidlawi (Fras.) (*Rhinocypha laidlawi*) Rec. Ind.Mus., vol. xxvi, pp. 482, 483 (1924).

Male. Abdomen 17–18 mm. Hindwing 20 mm.

Head black marked with bright vermilion as follows :—a large oval spot on dorsum of anterior part of epistome, a pair of large subtriangular spots behind the former on frons, two large tongue-shaped spots on vertex nearly confluent with former, closely apposed to the ocelli which they partially enclose. The latter spots changing from vermilion to pale ochreous at their hinder ends; a postocular spot on each side of occiput of the same colour. Eyes dark brown; labium pale yellow; labrum glossy black.

Prothorax black marked with creamy yellow as follows :—a narrow anterior collar, an oval spot on each side of middle lobe, a spot on each side of posterior lobe and a large spot on trochanters.

Thorax black, the mesothoracic triangle very narrow, very elongate, extending the whole length of dorsal carina, expanded in its lower third, with parallel sides in its upper two-thirds, bright vermilion red. The central part of alar sinus creamy yellow, laterally the lower parts of sides azure blue save for a small triangular area posterior to the humeral suture and a small linear spot on upper part of 2nd lateral suture. The dark area in front bearing a small upper posthumeral blue spot. Beneath thorax six large rounded yellowish spots, the anterior pair confluent.

Wings hyaline, the bases tinted with yellow, rather less than the apical thirds of all wings opaque black with a dark violety metallic reflex, the margin of this opaque area straight and sharply defined, not bearing any clear vitreous spots or stripes. Pterostigma black, swollen outwardly, oblique at both ends.

Legs black, the flexor surfaces of the two hinder pairs of tibiæ pruinosed white, the same pairs of femora very slightly so.

Abdomen black marked with bright azure blue on segments 1 to 8. Segments 1 to 3 broadly blue on the sides from base to apical border, segments 4 to 8 with a broad wedge-shaped spot tapering apicad but not reaching apical border of segments, gradually diminishing in size from 4 to 8. Segments 2 to 8 with narrow paired basal subdorsal blue lunules. Anal appendages black.

Female. Abdomen 17 mm. Hindwing 24 mm.

Differs from the male by the markings bright pale ochreous instead of vermilion and azure blue, and by its forewings entirely hyaline.

Head black marked with pale ochreous as follows :—two large oval spots on labrum covering the greater part of its surface, the same series of spots on upper surface of epistome and frons as seen in male, the bases of mandibles and a narrow stripe alongside each eye, as far as level of ocelli, the basal segments of antennæ, a small spot on each side of epistome, and lastly, the same postocular spots as seen in the male.

Prothorax similar to male but the middorsum bearing a stripe which runs from posterior lobe nearly to anterior end of prothorax.

Thorax black marked with greenish yellow as follows :—two minute spots on the antealar sinus, the middorsal carina finely, a fine antehumeral stripe, its anterior end curling abruptly outward, a short posthumeral stripe, incomplete below, a still shorter vestigial stripe just posterior to the upper part of first

lateral suture, a long stripe traversing the whole length of sides, crossing both sutures obliquely, its upper and lower borders very irregular and serrate.

Legs black, femora a dirty yellow on inner sides.

Wings hyaline, the hind with the apices broadly brown as far proximal to the inner end of pterostigma as its own length, and of a much deeper tint in the hinder two-thirds of wing. Anteriorly the cell-middles are hyaline, whilst at the apex of wing, the brown area is replaced by a small opaque white area. Pterostigma with inner half black, outer half whitish margined with black. Antenodal nervures 10 to 11 in forewings, postnodals 18 to 19 (10 to 11, and 18 to 24 in the male) ; discoidal cell of forewings traversed once only, rarely twice, in both sexes, 2 to 3 times in the hindwings. Petiolation beginning at inner end of discoidal cell in the female.

Abdomen black marked with bright ochreous and greenish yellow :—segment 1 with a large lateral spot and a minute middorsal linear apical spot, all segments from 2 to 8 with the middorsal carina finely yellow and from 2 to 7 with a long narrow stripe followed by a large apical spot on each side, whilst beneath this marking, on all segments, is a superventral stripe ; remaining segments unmarked.

Anal appendages black, long, acuminate. Vulvar scale as for genus.

Distribution. Confined to South Kanara, to the net-work of rivers about Sulia. I well remember the first discovery of this beautiful insect, when in company with Mr. C. A. Souter, I was making my way up the bed of the river in the Coorg—S. Kanara enclave. We had come to a fork in the stream and agreed to part company, each to work his own branch of the fork. Shortly afterwards I came on my first specimen which I mistook for a *Pseudagrion rubriceps*. Its size and conspicuous colouring led me however to glance at it a second time, when I at once recognized that it was something altogether new. I took eight males in all and when I rejoined my fellow shikari, found that he too had made the same discovery, having taken four more males (Nov. 9, 1923). Mr. Souter discovered the female on this same river in the following April, where I again found it later. For a long time, the discovery of a second species of *Rhinocypha* in South India has been visualized by Dr. Laidlaw and myself, so that it was very gratifying to come upon this insect. Dr. Laidlaw has pointed out to me the marked differences in venation and has suggested the removal of the insect from genus *Rhinocypha*, a suggestion here carried out. The type and co-type in the British Museum. Paratypes in the Fraser, Ris, Laidlaw, Morton, Pusa and Inglis' collections. The insect is a shade lover, albeit its bright colouring. It is found perched on half-submerged logs in midstream, or resting on twigs overhanging the river. The reds and blues are very conspicuous when the insect is in flight, whilst the black tips form an almost complete circle round it as the wings whirl with cinema effect.

Genus, LIBELLAGO, Selys.

Selys, Syn. Cal., p. 57 (1853) ; Id. Mon. Cal. p. 226 (1854) ; Walk. List. Neur. Ins. Br. Mus. vol iv, n. 643 (1853).

Moderately robust insects with characters very similar to genus *Rhinocypha* but differing less from that genus than does *Calocypha*.

Head, thorax and abdomen similar to *Rhinocypha*, but mesothoracic triangle undeveloped and uncoloured ; the abdomen, on the other hand, of the males, usually brilliantly coloured. Wings entirely hyaline in both sexes, narrow, the hind not noticeably broader than the fore, venation close, similar to that of *Rhinocypha*, except *MA* which is more or less zig-zagged for at least the outer part of its course, so that the cells bordering it are pentagonal instead of rectangular as in *Rhinocypha ;* petiolation ends well proximad of the inner end of discoidal cell. Legs variable, similar to *Rhinocypha* in the single Asiatic representative, similar to *Rhinocypha*, or widely dilated, in African species and usually brilliantly coloured. Anal appendages and genitalia very similar to *Rhinocypha*.

Distribution. Only a single species has been recorded from Asia, *L. asiatica vittata*, which extends through Burma and Tonkin, to the Philippines where it is represented by *L. asiatica asiatica*. The genus although so closely allied to *Rhinocypha*, is essentially an African one, and it is doubtful whether *asiatica* should be included in it, as the venational differences seperating it from *Rhinocypha* are not nearly as marked as they are in the African species of the

genus, nor is the abdomen marked as brilliantly as in the latter. The Asiatic species may be regarded as a link bridging the gap between the two genera, and raises a point of profound interest as to how, when and where the passage took place. Genotype—*Libellago dispar* Beauv.

Libellago asiatica vittata Selys, Ann. Mus. Civ. Genov. (2a), x, (xxx), pp. 58, 59 (1891); Will. Proc. U.S. Nat. Mus., vol. xxviii, p. 173 (1904); Mart. Mission Pavie, Neuropteres (sep.), p. 17 (1901); Laid. Rec. Ind. Mus., vol. xiii, pp. 39, 40 (1917).

Male. Abdomen 23 mm. Hindwing 33 mm.

Head black unmarked; prothorax black unmarked.

Thorax black with a fine posthumeral yellow stripe and two oblique dark ochreous bands on the sides. Legs black.

Wings hyaline suffused with brown at extreme bases, especially in the subcostal and median spaces as far as the basal antenodal nervure; 16 antenodal nervures, 19–22 postnodals in forewings, discoidal cells traversed twice or thrice; pterostigma black, about 2 mm. in length.

Abdomen black marked with reddish brown, segments 1 and 2 entirely black, dorsum of segments 3 to 8 reddish brown, the sides yellow, as well as the dorsal carina finely; apices of segments narrowly, and the whole of segments 9 and 10 black. Anal appendages black, superiors twice as long as segment 10, slender, curving in towards their apices which are a little spatulate; inferiors cylindrical, separated, curving in at apices, about half the length of superiors.

Female. Abdomen 20 mm. Hindwing 30 mm.

Head. Labium black; labrum black with a large diffuse rounded central spot of pale yellow; bases of mandibles, a large spot on the sides of epistome, another on the sides of frons, the basal segments of antennæ, the cheeks broadly, a small oblique spot on the outer sides of the posterior ocelli and a rounded postocular spot on each side of occiput pale creamy yellow.

Prothorax black, the lateral ends of posterior lobe and a large spot on each side of middle lobe pale yellow.

Thorax black marked with a pale greenish yellow antehumeral stripe incomplete above, where however, is an isolated spindle-shaped spot of ochreous; a bright ochreous elongate posthumeral upper spot, at the lower end of which, and on the dorsal side of the humeral suture, is a somewhat smaller triangular spot; laterally the whole of the lower half of mesopimeron, and the whole central portion of the metepimeron as well as a small curved stripe behind the upper part of the first lateral suture bright ochreous. Beneath thorax a broad transverse stripe behind the legs, followed successively by a large arrow-head shaped spot and a broad terminal stripe all ochreous.

Legs black, coxæ and trochanters yellow, proximal ends of all femora yellowish brown.

Wings hyaline, the extremity of all apices clouded narrowly with blackish brown; 15 to 16 antenodal nervures in forewings, and 17 to 18 postnodals, 16 antenodals and postnodals in hindwings. Discoidal cells traversed thrice; the nervure *ac* well proximad of inner end of discoidal cell; petiolation beginning at level of 2nd antenodal; pterostigma blackish brown, longer than in male.

Abdomen black marked with yellow as follows:—segments 3 to 8 with a narrow middorsal carinal stripe, segments 1 to 7 with the sides broadly yellow, this colour expanding dorsalwards at apical ends of segments; segment 8 with a rounded apico-lateral spot.

Anal appendages black, long and narrow, pointed. Vulvar scale as for *Rhinocypha*, black with a large medio-lateral bright yellow spot.

Distribution. Bhamo, Burma, within Indian limits, June and July. Reported also by Martin from Tonkin. Type in the Selysian collection. Appears to be a rare insect wherever taken.

(*To be continued.*)

Note:—In part xxvii, Indian Dragonflies of this volume, by a printer's error, the figures have been transposed. Fig. 1 should be Fig. 2 as regards the explanatory text, and *vice versa*.

A SIND LAKE

BY

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(With six plates and three Text figures)

This is the narrative of a delightful New Year week spent on the Manchar, perhaps the largest fresh water lake in India, and certainly the most enthralling from the point of view of the sportsman and ornithologist.

Situated in the Larkana District, the Manchar, like all the other numerous *dhunds* (*jheels*) of Sind, owes its existence principally to the annual inundations of the river Indus. A portion of the Indus waters reaches the Manchar by a natural and very tortuous channel known as the Western Nara, and again finds its way back to the parent river through another—the Aral. This latter commences at a point near the dusty little town of Sehwan whose chief pride at the present day lies in the dilapidated ruins of a mud-and-brick fort claiming an abstruse connection with the invasion of Alexander the Great, and in the annual fair held at the *dargah* of a *pir* long-defunct but who continues to perform his miracles notwithstanding.

The Manchar, in other words, may be regarded merely as a local expansion of the Western Nara Canal; during inundations when the level of the Indus rises much higher than that of the lake, the Aral discharges water into the Manchar; when these floods subside, the current is reversed and the water carried back to the river. A vast expanse of land—20,000 acres or more—is exposed by the post-monsoon drying or draining off of the lake which is extremely fertile and valuable for the cultivation, of *rabi* crops such as wheat and gram. It is these cultivations, incidentally, that afford attractive pasture to the innumerable hosts of geese and cranes which constitute such a salient feature of the bird-life on this wonderful lake.

Unfortunately for the bird-lover, by reason of this very fertility of the soil left high and dry by the retiring floods, the days of the Manchar as a wildfowl resort are numbered. A mammoth scheme is afoot for draining off the lake more or less completely in the cold weather so as to render the greater part of its bed available for cultivation. The disappearance of these extensive feeding grounds will doubtless produce a marked effect on the bird-life not only of the district but of the province of Sind as a whole, especially as the project is expected to come into operation simultaneously with the mighty Sukkur Barrage and its intricate network of canals, with the consequent opening up of enormous tracts of hitherto unpopulated country.

As a whole, the waters of the Manchar are shallow, ranging from a few inches in depth to eight or nine feet. The surface of the marginal

shallows is covered with tangles of the floating lotus plant (chiefly *Nymphæa lotus* and *Nelumbium speciosum*) which grow in unbounded profusion in every *dhund* in Sind. These in the Manchar yield a considerable revenue to Government. The roots of both, called *Lorh* and *Beeh* are extensively used as food, as a substitute for potatoes and in many other forms—whilst their seeds or nuts (*Nápo* and *Pábúro*) are also much eaten and sold in the bazaars.

Apart from these littoral lotus tangles, the shallows abound in reeds and sedges affording ideal shelter to countless myriads of wildfowl of every description which, driven by the bitter cold and scarcity of food from their northern homes, migrate southwards and find an agreeable haven in their hospitable seclusion.

We were encamped in the District Local Board bungalow at Shah Hassan, a tiny village on the western shore of the Manchar, between its waters and the desolate looking Kirthar Range which forms the natural boundary between Sind and Baluchistan. The road to Shah Hassan from our last camp ran for a good way by the margin of the lake, and all along in the distance could be descried millions of waterfowl, floating on the water lumped together, looking like immense floating islands, while the terrific honking, quacking and 'spattering' set up by the birds sounded like the distant grind of some weird machinery. Every now and again there passed over or in front of us within distinguishing range, flocks of various species of duck, and skeins of Grey Lag Geese leisurely winging their way lakewards from the direction of the Kirthar where they retire nightly to feed on the beloved grit which the hills supply.

A chronicle of one of these memorable days spent on the lake will suffice as sample.

We left the bungalow soon after daybreak in punts, each punt manned by one gun, a shikari and three *mohanas* with poles. The mohanas or 'mirbahrs' (literally 'sea-lords' or 'Admirals'!) are Mohomedans of what one may call an amphibious species. They spend their lives on or near the River Indus or one of the numerous *dhunds* created by its monsoon inundations, and eke out a bare livelihood by plying boats, gathering lotus seeds and roots, fishing and capturing wildfowl in a number of ingenious ways, some of which are hereafter described. Some of the more enterprising ones also go in for farming egrets, an industry which holds much promise when the traffic in plumes is legalized. Fatigue is a thing unknown to these 'sea-lords' and it is remarkable how they will go on punting almost incessantly all day without exhibiting any symptoms of it.

We glide placidly over the limpid waters in the direction of the butts that have been prepared overnight in the neighbourhood of a bank where Grey Lag Geese have been observed to congregate in the mornings before repairing to their favourite feeding grounds among the tender gram and wheat fields hard by the margin of the lake. A piercing north-easterly wind is blowing which strikes our faces like needles, and pierces through great-coat, tweed jacket, and thick Jaeger vest to the very marrow of our bones. We sit on the bow of our punt with our heads snugly buried to the ears in the collar of the trusty great-coat and our hands thrust well down its grateful pockets. In our course, we disperse immense flocks of

coots, with which are mingled odd parties of gadwall and other species of duck. The Manchar is, and has long been, notorious for the masses of coots it harbours, but their numbers are totally inconceivable until you actually see them and can believe your eyes. Great patches of the lake are literally blackened with their multitudes and their ' spattering ' on the water as they attempt to rise, is positively bewildering to the new arrival. Inspite, however, of the wholesale slaughter and destruction that proceeds apace from the time the coots arrive till their return migration at the commencement of the hot weather, their numbers appear to remain unaffected, and the legions that visit the country again the following season show that the coot is one of those fortunate species that is in some way exceptionally well-fitted in the struggle for existence, and stands in no immediate danger of extinction.

But to continue with our narrative. Owing to exceptionally heavy inundations of recent years, the greater part of the thicker reed-beds on the Manchar which erstwhile provided such admirable cover to the sportsman have disappeared, rendering satisfactory sport none too simple a proposition. The butts or ' hides ' in the present instance consisted of a few twigs of tamarisk thrust into the lake-bed to conceal the punts, there being no natural cover at hand. These were arranged in a row at distances of 40 yards or more from each other. We soon take up our positions, and at a given signal the drive commences. Some of the punts have gone ahead to round off the birds, while others are stationed at a distance in the rear to turn the birds back over the guns. The first to take alarm are a party of Pintails—all males keeping together. They fly low and unsuspectingly over the central ' hide ' from where the right rings out, followed by the left in quick succession. These are accommodatingly responded to by splashy thuds as two of the fat birds pay the penalty of blissful ignorance. The flock breaks up to right and left at lightning speed, and the birds lose no time in rising well out of range.

The reports of the gun rouse the other habituès of the lake into action and now follows a sight that can never be forgotten—a sight that must leave an indelible impress on the mind of every sportsman who shoots on the Manchar. The birds rise in their thousands to the accompaniment of a veritable babel of flapping, swishing, spattering, honks, quacks and a variety of other noises. Now come the pochards and the shovellers, spotbills, mallard and teal all in a jumble, some swishing past in orderly flocks overhead, others flying singly or in twos and threes. The clouds of mixed species that rise, soon resolve themselves into little parties of their own. Unfortunately the wind keeps up and spoils the fun. The birds get steadily higher and higher and are soon quite out of range. Our gunners have been feverishly active all this while, and the firing has been fast and furious. The average of kills however, dwindles off appallingly after the first few fusilades, and in the later stages of the shoot the sportsman has to rely more upon his luck than on his skill.

In a very short time the birds have disappeared. The firing now becomes sporadic and far between as an occasional mallard or white-eye returns blundering past to reconnoitre ground so lately



1. NEGOTIATING THE REEDY MARGINAL SHALLOWS.



2. NEARING THE BUTTS.
(Note masses of wildfowl in the background).



3. THE FOWLERS LEAVING THE PUNT.



4. THE FOWLERS ABOUT TO ENTER A FLOCK.

evacuated. Very good sport may sometimes be had at this stage, as the gunner need be in no hurry, and the tendency to 'brown' flocks, which is perhaps the most important cause that contributes towards unsatisfactory averages, is eliminated.

None of the Grey Lag Geese which formed such an imposing array on the mud-banks in our front have come our way during the drive except a pair, of which one fell and the other was disgracefully missed. During operations, a great many skeins have been noticed flying over, well out of range, in the direction of the young wheat and gram on the farther margin of the lake. The masses that rose at the first shot have also made a bee-line for these parts. A hasty confab of the shikaries decides that our acquaintance with the birds might be renewed with advantage, and we push off. All the way in the punts, flock upon flock of the geese are observed leisurely winging their way towards their rendezvous flying studiedly out of range and frankly disdainful of our murderous aspirations. Notwithstanding the obvious, the more enthusiastic section of our party have been totally incapable of restraining the trigger-finger. On the universally accepted and sound principle that accidents *will* happen in the best regulated households, the Mannlichers are brought into action, but magazine after magazine has failed to disturb the complacence of the assaulted, who doubtless regard it all as a rather meaningless and totally unnecessary demonstration on the part of the human biped.

True, one 'accident' did happen. A stray bullet caught the leader of a wedge plumb in the centre of his fat body blowing his back completely away, and the bird arrested dead in his flight as if by a stroke of heart failure, hurtling down like a stone through 500 feet or more of space presented a remarkable spectacle. This event of course roused hopes which conduced to dissipate ammunition in the shortest possible time!

In an hour we are on the farther shore. Punts are discarded and a rigorous tramp of about three miles over slushy ground brings us within reach of our objective. By the time we arrive at our destination it is 10.30. The distant fields, as far as the eye can reach, are one seething mass of jostling Grey Lags, but the total absence of suitable cover presents a problem. The shikaries however are up to the game. They put their heads together and we soon find ourselves hustled along to within a few hundred yards of the birds—now crouching, now crawling on all fours, now halting motionless then again running cautiously forward taking the fullest advantage of every unevenness the ground offers. Here we are made to squat behind diminutive tussocks of grass in ankle-deep water, all in a line at intervals of a hundred yards or so. The beaters who have gone ahead in the opposite direction, seeing us safely ensconsed, commence walking towards the birds. The foremost to scent trouble are the odd parties feeding on the outskirts who rise, as often as not to settle again after circling the fields. When the men have managed to edge themselves more or less into the centre of the congregation, the shout is raised. The sight that now ensues completely baffles description. Momentarily your horizon is obscured by dense masses of Grey Lag Geese and the din of their honking is

such as to render the various excited injunctions of your shikari positively inaudible. The birds spread themselves over a vast front. The guns have been placed directly in their line of retreat to the lake, and you presently see a few thousands coming your way. You crouch and prepare to send up your greetings, cylinder and choke, but before you have been able to gauge the range, the great multitude have swept over, and now come smaller skeins which happily are flying lower. You hear shots from your neighbours and occasional heavy splashes in response. The birds swerve to right or left, but before they can rise much higher they are directly over you. If you remain cool and collected and pick out your birds before firing, a couple of rights and lefts will bring you two brace without difficulty. If ambitiously inclined, however, and aspiring to a record bag by 'browning' the flock, you will as likely as not be left cursing your stars with a clear blue sky above and precious little to compensate for it in the nature of birds in hand!

This briefly is the typical programme of a day's shooting on the Manchar, which with sundry variations may be experienced by all sportsmen who shoot on the lake.

A couple of days were spent in watching the wildfowl netting and fishing operations of the mohanas, which proved both enjoyable and instructive.

The flesh of the coot, though somewhat rank and fishy to 'sophisticated' palates is held at a premium by the Sindhi, especially of the poorer classes. He prefers it to duck and other wildfowl, and the coot accordingly is a coveted object of the mohana's attentions and devices.

There are numerous little villages and hamlets by the shores of the Manchar and most of the larger *dhunds* in Sind, the inhabitants of which subsist throughout the cold weather months either on the flesh of this unfortunate bird or otherwise by the wherewithal provided by traffic therein. In the neighbourhood of every such village may be seen masses of coots' feathers which bespeak the sad fate of the many gone before. Coots sell in the villages at about two annas a piece, and owing to their ready demand, bring brisk business to the fowler. A very common method of capturing the birds is for a man to wade into the shallows frequented by the coots, wearing on his head in the form of a cap, the complete skin of a duck with head and neck properly set up, and provided with breathing and eye-holes for the fowler. Under cover of this deception he stalks gradually up right into the midst of an unsuspecting flock, nothing visible except the harmless looking decoy on his head. When well within the assembly, the fell work commences. A bird is grabbed by the leg under water and in the twinkling of an eye, before it has time to flutter, the victim disappears below the surface. Its legs are bound up with water weeds and the captive firmly secured to a belt round the fowler's waist. The other members of the flock have noticed nothing of this foul treachery, and are as confiding as before. Presently a second bird disappears, a third follows rapidly, and then a fourth. Shrewd suspicions now begin to cross the minds of the silly coots and misgivings become apparent as to things being as they should; there is certainly something



5. A SUCCESSFUL CATCH.



6. THE *Gazis* IN ACTION.



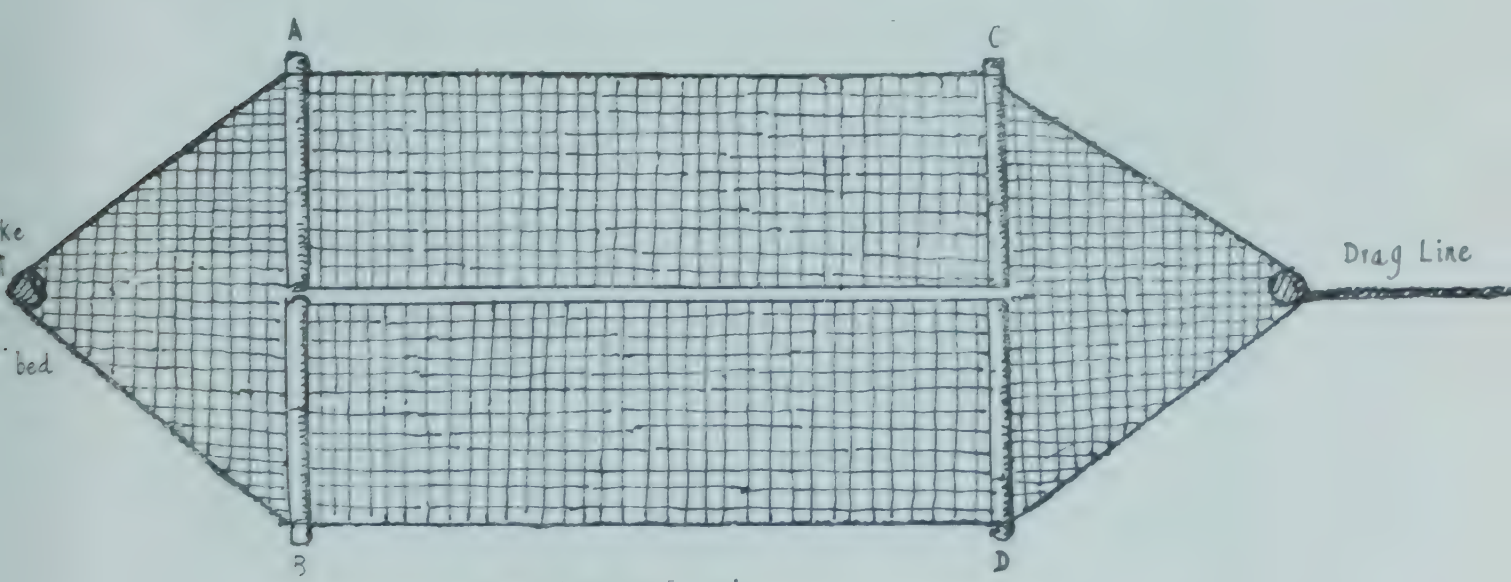
7. RED-CRESTED POCHARDS IN A *Dhubbi* NET.



8. REMOVAL OF CAPTIVES FROM *Dhubbi*.

wrong somewhere! A number of the birds spatter away some distance from this mysterious duck, but are too dense however to detect that unlike other self-respecting ducks, this one of their suspicions that follows steadily, progresses backwards or sideways! The eye- and breathe-holes for the fowler are placed near the vent and undertail coverts of the skin, so that the decoy and the man below are facing in opposite directions! When the fowler has gathered half a dozen birds or so below the water, he fastens their legs together and moving off some distance from the flock, he allows his ring of captives to come to the surface for breath. It not infrequently happens that when sport is good and the fowler ambitious, some delay occurs in this very necessary operation with the result that several of the hapless prisoners are drowned. Leaving the knot of captured birds on the water, the wily mohana again sidles into the flock and the process is repeated. Thus it is not unusual for twenty or thirty birds to be taken by a single man in the course of a morning's work. Duck are also taken in this manner, but the stupidity of the coot lends itself particularly to this device, and they make by far the more ready victims. By way of a variation, in place of the duck-skin cap a tame cormorant is frequently perched on the man's head, and the bird appears to participate whole-heartedly and to enjoy the sport thoroughly. This method of fowling is of great antiquity and has been pursued through the ages practically unchanged in every detail. It was greatly in vogue in the time of the Emperor Akbar.

A method of netting wildfowl on a somewhat larger scale is known as the *Dhubbi*. Here a net, about 30 feet × 20 feet is stretched on the shallow bed of the lake at a favourite feeding ground of the birds. A quantity of grit from the neighbouring barren hills is sprinkled over the net by way of bait. A drag-line, 200 yards or more, is attached to one end of the net by the pulling of which the net closes up in the form of a Gladstone bag.



Open "Dhubbi" Net
When net closes A meets B and C meets D.

Fig. 1.

The fowler with the loose end of this line conceals himself and his punt among the reeds at a distance and keeps a vigilant look-out. While 'tipping' about for food, the presence of the grit is discovered by the birds and this marks a general scramble for the spot within the sphere of influence of the hidden net. Now is the time for the fowler to get busy: the line is pulled steadily and gradually till one final and mighty heave leaves the birds entangled. One of my photos shows thirty-five Red-crested Pochards taken in a net of this size. The fowler now approaches, and removing one captive after another, proceeds in the most matter of fact manner to interlock their wings—twisting one wing round the other over the back—and to dump the birds mercilessly into his punt prior to packing them up in crates for despatch to Karachi and other markets.

On a vaster scale, and for business on wholesale lines, the *modus operandi* of the mohanas is as follows :—

A flight-net about 12 feet high and a quarter of a mile or more in length is stretched on upright poles across a portion of the lake in the proximity of some favourite feeding ground, with due regard to direction of wind, etc. This net is turned up at the bottom, just below the water-line, to form a continuous bag running all along the the lower border. A quantity of the beloved grit is dropped along the length of this net. Ducks, geese, coots and other wildfowl gather in their hundreds to feed on this spot at night, and under cover of the darkness a number of punts move up in line formation from the opposite direction collecting and driving the unconscious birds towards the net. When the punts have advanced to within thirty yards or so of this 'barrier of twine', a signal is given and a terrific uproar set up. Lighted faggots and torches are all of a sudden hurled at the birds who rise in distraction and attempt to flee in the opposite direction. Before they are able to get well under way and rise high enough to clear the cryptic net, they dash into it headlong to be thrown down fluttering into the gaping bag below, whence they are soon extracted by the mohanas who hurry forward anon. In this manner a thousand or more birds may be taken in the course of a single drive.

A rather sporting method of procuring coots for the pot is frequently indulged in by the mohanas. The gadgets employed in this sport are a powerful bow made of bamboo and a number of blunt, headless, unfeathered arrows, about three feet in length and three-quarters of an inch thick. The hunters approach a flock of coots in punts and divesting themselves of their clothing to very nearly the irreducible minimum, launch into the waist-deep water where they crouch submerged up to their chins in a row at intervals of fifteen yards or thereabouts. The punts move off to round up the birds and drive them towards the bowmen or *Gazis* as they are called. For some time the coots continue to swim away from the advancing punts and in the direction of the archers, but on being pursued closer, they attempt to rise. They spatter along the surface before taking off, and by the time they are over the line of bowmen they are scarcely higher than fifteen or twenty feet. The men who have hitherto been immersed to their chins with bow and arrow in readiness under water, suddenly pop up and discharge their



9. AN EGRET FARM ON THE MANCHAR.



10. INTERIOR OF THE SAME.



11. FISHING ON THE MANCHAR—LANDING THE CATCH.



12. ANOTHER SNAP OF THE LANDING OPERATIONS.

missiles. The arrows strike the birds crosswise, i.e., on the flat, and often with such force as to take a wing clean off. The men are such adepts at the game that misses are a rare occurrence, and a volley from half a dozen bowmen seldom accounts for less than four or five birds.

The mohana's methods of fishing also afford interesting watching, and the industry and hard labour entailed by some of the less wholesale systems leave one in strong doubt as to whether after all the zeal displayed is not worthy of a better cause! He will spend the best part of a morning—his family in full strength participating—rocking his boat from side to side and creating the most deafening and unholy row with tom-toms and copper 'dekchies' in attempts to drive the fish into the nets he has put up at a distance, and when

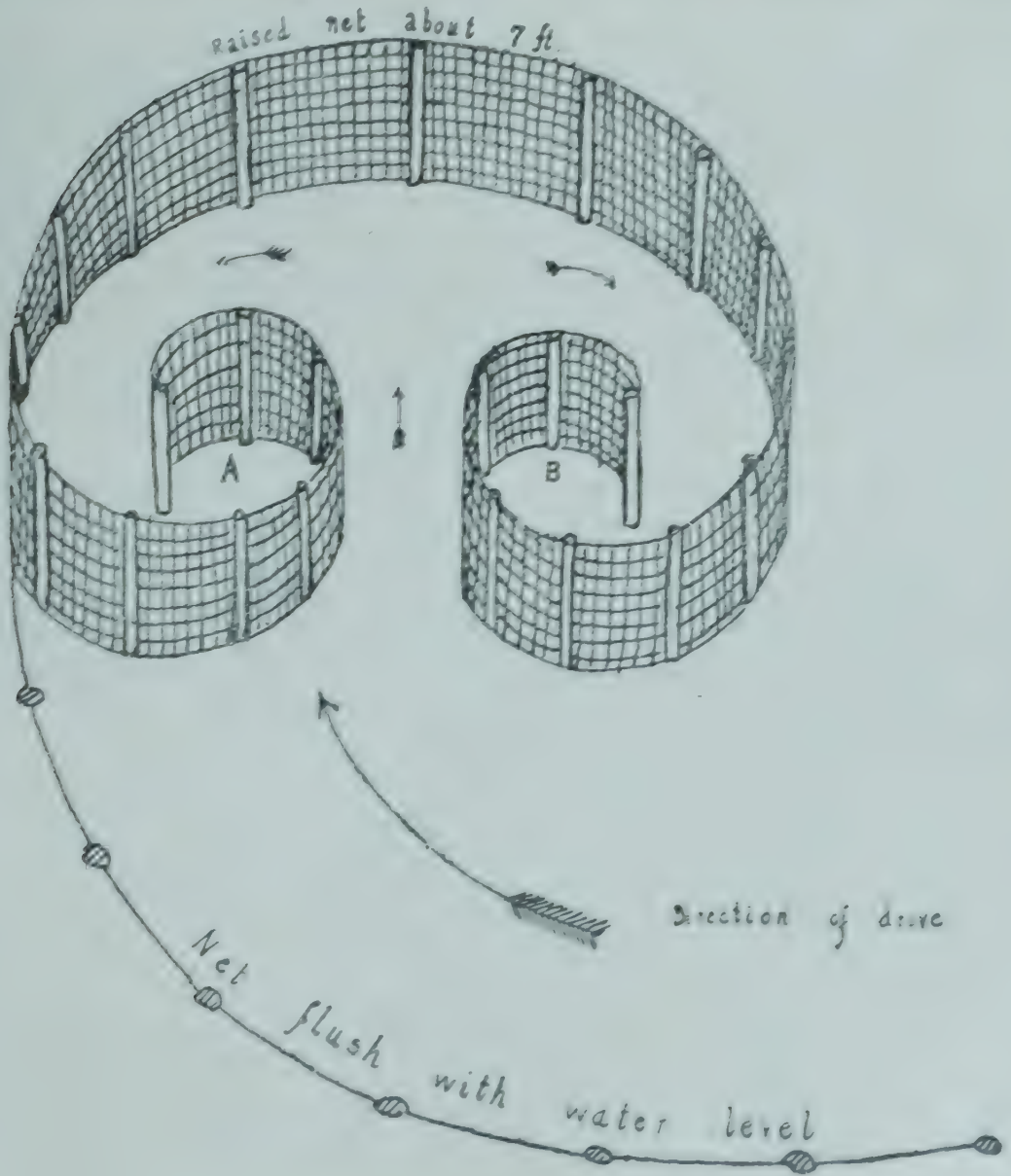


Fig. 2

everything has gone off well and 'according to programme', he will pull out a single fish or sometimes a couple—a catch not worth more than four annas!

In one of the methods most commonly employed, the nets are arranged as shown in Figure 2.

The fish are finally driven into the enclosed spaces marked A and B whence the mohanas land them by diving, or if the water be shallow, by means of a hand net like the one shown in the photo (No. 11.)

The most important fish of Sind is the *Pala* (*Clupea ilisha*). It is a sea fish belonging to the same genus as the herring, and ascends the Indus in the months of February and March for spawning in enormous numbers. For a short period at this time, this species fairly swarms the Manchar. Next in importance come the *Dambhro* (*Labeo rohita*) which may grow to a length of three feet, and the *Mori* (*Cirrhina mirgala*). Two specimens from the lake sent to the Indian Museum, Calcutta, have been identified by Dr. S. L. Hora as these species.

When the catch is not large enough to warrant its being carried to market, the fish are kept over till the next day, the day after, or even longer. The mohana, on withdrawing a fish from the landing net, probes deep into the animal's side just below the spinal chord with a large skewer-like needle. Having thus paralysed his captive, he proceeds in the most callous manner imaginable to drive this same needle threaded with twine through one eye-socket and out through the mouth. The fish along with other hapless ones is now secured to the punt and the bunch is left floating listlessly on the water in a comatose condition till gathered in and carried off to market. It is thus that the mohana always manages to supply 'fresh fish'!

Apart from duck-shooting, which is *par excellence* the sport of Sind in general and of the Manchar in particular, by far the most engrossing charm of the Manchar lies in the unequalled variety of bird-life it presents. I mention only a few of the species met with in the course of a day's casual observation when the main object was shooting. This is only a very small fraction of the species I was able to recognize, and in addition there were a host of others which could not be identified for obvious reasons.

Flocks of Starlings, chiefly from five to twenty birds but sometimes hundreds, kept about the margins of the lake feeding on the semi-marshy grassland whence the water had lately receded. A specimen obtained proved to be *Sturnus vulgaris nobilior*.

Wagtails were plentiful, both along the margin of the lake and in the shallows overgrown with the lotus plant, where they could settle on and hop about from one floating leaf to another. The commonest species—specimens of which were secured and have since been identified by Dr. C. B. Ticehurst—were: (1) The Indian White Wagtail (*Motacilla alba dukhunensis*); (2) The Blue-headed Wagtail (*M. flava melanogriseus*); and (3) The Yellow-headed Wagtail (*M. citreola*).

The Pied Kingfisher (*Ceryle rudis leucomelanura*) was perhaps the commonest kingfisher. Seen mostly in parties of four or five. Extremely pretty to watch as he hovers stationary over the water and hurls himself head foremost at some unsuspecting fish from a height of fifteen to twenty feet. The small *Alcedo atthis pallasi* was

also not uncommon. His tactics as a general rule differ from those of his pied cousin. He sits on a branch rarely five or six feet above the surface and drops perpendicularly on a passing fish with which he flies off to a neighbouring perch.

The Indian Purple Moorhen (*Porphyrio poliocephalus poliocephalus*): This bird was an extremely common frequenter of the reed beds, where it must breed. An immature male was caught by the mohanas by surrounding a patch of reeds in which it had taken refuge, being unable to fly well. It looked lean and lanky. The iris were brown ; bald patch on forehead and bill black, slightly reddish on lower mandible. Legs and feet pale orange brown.

Coot (*Fulica atra atra*): As mentioned before, this is without doubt the most abundant species on the lake. Besides the incessant ravages of man, a great many fall victims to the numerous species of accipitrine birds that ceaselessly beat over the waters of the *dhund*. I was the fortunate witness of a raid on a flock of coot by a large eagle, the species of which I was unable to ascertain owing to the distance. It was I think either the Imperial Eagle (*Aquila heliaca*) or the Large-spotted Eagle (*Aquila clanga*) both of which were common about the locality. The plan of attack was interesting. The eagle swooped down on the compact flock (about 200 birds) and in this first bout broke it up. Several of the coots spattered off, some dived below the surface while others swam away as fast as possible from the scene of assault. The eagle renewed the attack three or four times, till, having made confusion worse confounded, it succeeded in isolating from the flock an individual which promptly dived. This was the assailant's opportunity. After a couple of unsuccessful stoops, whenever the coot appeared on the surface for breath, the eagle bore down on him like a hurricane and carried him away in his talons.

In this particular case I was able to notice nothing of the singular manner, often described, in which coots are said to defend themselves against eagles. It has been recorded that on the appearance over them of one of these birds, the coots collect in a dense body and when the eagle stoops at them, they throw up a sheet of water with their feet and completely baffle the enemy.

No cranes, neither *Megalornis grus lilfordi* nor *Anthropoides virgo*, were seen. I was informed that it was as yet somewhat early for them and that they swarmed the localities, especially round our latter camp, Janghar, in January and February when the crops were fully grown.

White-tailed Lapwings (*Chettusia leucura*) were fairly common along mud banks, feeding in companies of four or five birds.

The Black-tailed Godwit (*Limosa limosa limosa*): This bird was extremely abundant on the shores of the lake near Shah Hassan. Their numbers must run into tens of thousands, and large patches near the margin of the water were literally obscured by their multitudes.

The Caspian Tern (*Hydroprogne caspia caspia*): Numbers of this beautiful tern were seen flying over the lake. When one of the specimens I shot dropped into the water, it was immediately swooped upon by a Marsh Harrier (*Circus æruginosus*) which is perhaps the

most numerous species of the Accipitres about the lake. This bird was also secured.

The Black Ibis (*Inocotis papillosus*): Flocks of from twelve to twenty birds, feeding on the drier portions of the lake margin.

The Glossy Ibis (*Plegadis falcinellus*): Parties of twelve to fifteen birds appeared to be the usual thing. When flying away from or coming towards one in their usual V formation, they are easily mistaken for geese at a distance.

The Large White Egret (*Egretta alba*): Only two pairs were seen and one specimen secured. The birds were very shy and wary. Measurements of this specimen were as follows: Bill from forehead feathers, 127 mm., tarsus 214 mm., bill yellow; legs and feet greenish-black.

The Bar-headed Goose (*Anser indicus*): It was significant that during the three or four days spent at Shah Hassan not a single bird of this species was seen. When camp was shifted to Jhangār, about eight miles eastward, it was found that all the geese frequenting this portion of the *dhand* were *indicus* and no Grey Lags were observed. The two species appeared to have apportioned off distinct zones. The numbers of these birds were considerably less than those of the Grey Lag at Shah Hassan. Some large flocks were seen feeding on the young wheat and gram by the *dhand* in the early mornings and at sundown. They feed throughout the night and repair to the open water during the day where they ride on the surface and rest.

Among the ducks, the commonest species by far appeared to be the White-eyed Pochard (*Nyroca rufa rufa*). This bird is an expert diver, and unless squarely hit it dives and holds on to the submerged water weeds and is then extremely difficult to recover.

The Little Grebe (*Podiceps albipennis*): This little bird is also extremely abundant in the shallows. Flocks of fifty to sixty birds were common, and the rapidity with which they dived was indeed remarkable. When fired at, in many cases they had almost disappeared below the surface before the charge reached them! My diary records the following peculiarity as regards the colouration of the irides in fresh specimens which in the Fauna (*Birds*, 1st edn. vol. i, p. 475) is stated to be 'red-brown'.

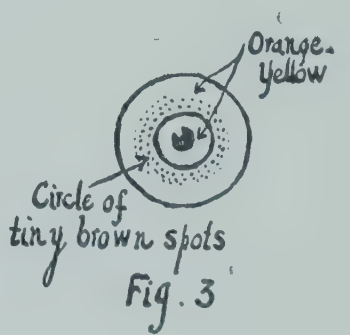


Fig. 3

Some of the other birds seen on the lake and in its precincts were:

The Spoonbill (*Platalea leucorodia major*); Large flocks on mud banks.

The Common Heron (*Ardea cinerea cinerea*): Quite common. Seen singly.

The Desert Buzzard (*Buteo buteo rufiventer*): Seen usually in pairs perched on mounds near the lake. Obtained a specimen.

The Pale Harrier (*Circus macrourus*): Extremely common. Continuously beating over the shallows everywhere.

Before concluding, a few hints as to how a shoot on the Manchar can be arranged may prove useful to intending sportsmen.

It is best to get into communication with the Deputy Collector of Sehwan (Larkana District) and inform him well in advance of the dates on which you propose to shoot. The stations to get down at are either Sehwan or Bubak Road on the N.W. Rly. (Karachi-Lahore) at both of which places tongas can be easily got. If you leave Karachi at 11 p.m. you reach Sehwan at 9 a.m. the next day, and Bubak Road is only 20 minutes further on. About Rs. 5 per day for a punt and crew would be enough.

There are no bungalows on the Manchar. The P. W. D. Bungalow at Bubak might be used. The Local Board Bungalow at Shah Hassan where we stopped is a long way from the Railway.

THE LANGURS, OR LEAF MONKEYS, OF BRITISH INDIA

BY

R. I. POCOCK, F.R.S.

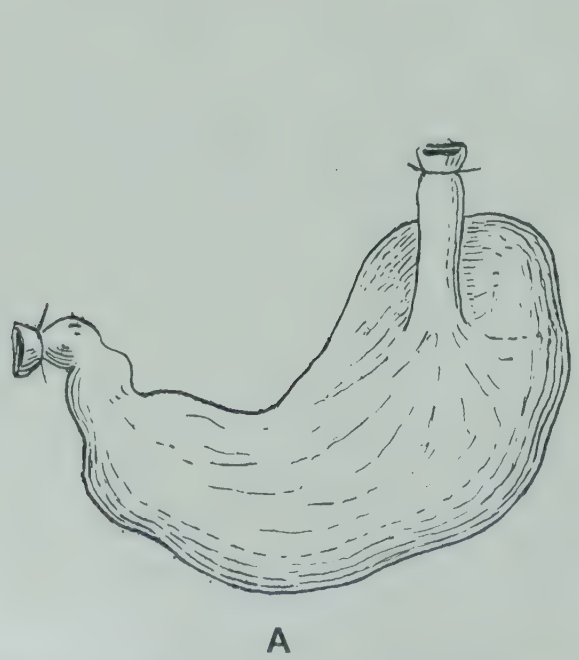
(*With 1 coloured and 1 black and white plate and 21 text figures*)

THE DIFFERENCES BETWEEN THE LANGURS AND THE MACAQUES

Although the name Langur is, strictly speaking, the Hindi title for certain Monkeys restricted to the northern parts of India, it has been extended during recent years to include a great variety of related forms widely distributed in the East. In this paper I have adopted it for all the eastern monkeys which are not Macaques.

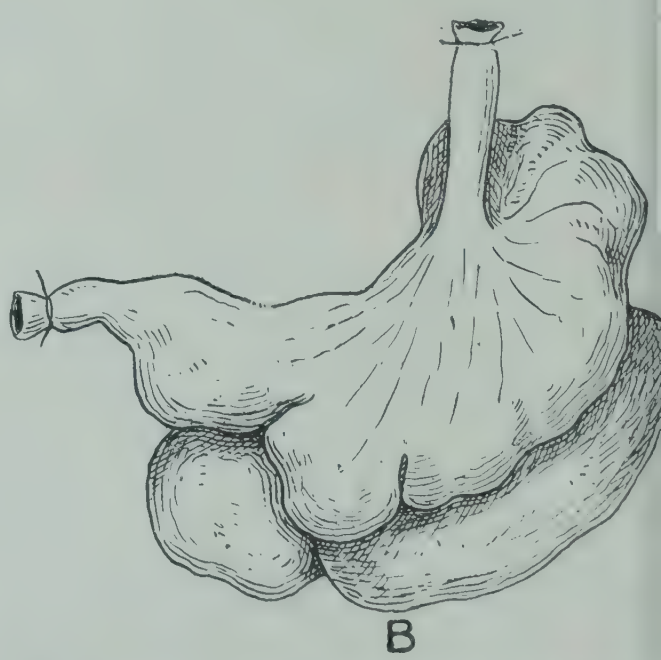
The Langurs are found. mostly in thickly forested districts, throughout British India from Kashmir and Upper Burma in the north to Ceylon and Tenasserim in the south. Outside that area they extend into southern China and Siam and through the Malay Peninsula to Borneo. There are several genera; but the only one which, as occurring within the British area, concerns us at the present time, is the genus now called *Pithecus*, which was formerly better known as *Semnopithecus* or *Presbytis*.

Except where regarded as sacred and encouraged to enter native villages, Langurs avoid the presence of man and are essentially dwellers in the tree-tops, feeding mainly upon leaves, shoots and buds and, in case of alarm, passing from branch to branch with prodigious leaps or swinging from one branch to another by means of their arms somewhat after the manner of Gibbons. They are less terrestrial and more arboreal than the Macaques and differ from them also in diet. And the differences in these respects between these two groups of monkeys are accompanied by important structural modifications connected with the digestive organs and limbs. The Macaques have large cheek-pouches and a comparatively small, simple stomach, whereas in the Langurs there are no check-pouches and the stomach is capacious and sacculated. In the second place the hands and feet of the Macaques are shorter and broader than in the Langurs and have a larger thumb and great toe. (Text figs. 1A, 1B, 2A, 2B, 3A and 3B.)



A

FIG. 1.—A. Simple stomach of the Common Macaque (*Macaca irus*) from the Malay Peninsula.



B

B. Sacculated stomach of Ceylonese Langur (*Pithecus senex vetulus*).

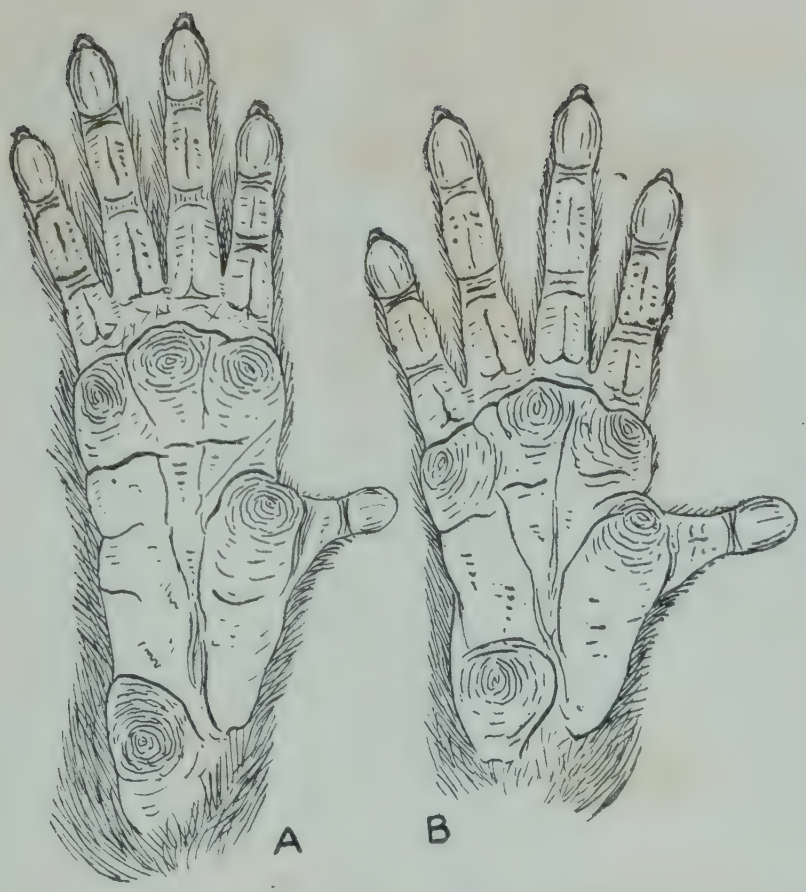


FIG. 2.—A. Hand of Indian Langur (*Pithecus entellus*). Half nat. size.
B. Hand of Malabar Macaque (*Macaca silenus*). Half nat. size.



FIG. 3.—A. Foot of Indian Langur (*Pithecus entellus*). Half nat. size.
B. Foot of Malabar Macaque (*Macaca silenus*). Half nat. size.

These differences are expressed by referring the Macaques and Langurs to two distinct families, the Macaques to the *Cercopithecidæ*, which also includes the Baboons, Mangabeys, and some other African Monkeys, and the Langurs to the *Colobidæ*, which also includes the Guerezas (*Colobus*) of Central Africa.

The Classification of the Langurs

For the original descriptions of the Langurs of British India we are indebted to many authors, more particularly to Blyth; but the most important attempt to deal with them comprehensively was made by Anderson, who not only had in his hand Blyth's specimens in the Calcutta Museum, but also made a point of seeing, where possible, the specimens described by French, Dutch and other foreign zoologists and preserved in the Museums of various countries in Europe. This work which is a monographic revision of all the species of Langurs, then called *Semnopithecus*, known up to that time, was published in 1878 in the *Zoological Results of the two Expeditions to Western Yunnan*. It was an important treatise and formed the basis of Blanford's account of the Langurs contained in his classic volume of the *Mammals of British India*, published in 1891, and of Forbes's account of these monkeys in vol. ii of his *Handbook of the Primates*, 1894. But the arrangement and treatment of the species in the three volumes cited does not attest any clear understanding of their mutual affinities on the part of the authors; and this statement is still more true of Elliot's classification of the Langurs contained in vol. iii of his *Review of the Primates*, published as recently as 1913.

On working through the collection in the British Museum, I find evidence that the Langurs of the genus *Pithecus* may be divided primarily into three groups sharply distinguishable by the colour of the newly-born young; and this character is sometimes correlated with others in the skull, coloration or other external features of the adult which make it possible to assign with some degree of assurance to one or the other of the groups those species in which the coloration of the young has not as yet been ascertained.

These groups may be defined as follows :—

Group I.—Newly born young, a uniform dark blackish-brown all over. (Plate I, fig. 3).

This group, which may be called the *Entellus*-group, since the Entellus Langur is the best known species contained in it, is restricted to India and Ceylon and ranges in suitable localities throughout those countries from the Himalayas southwards but does not, so far as is known, cross the Brahmaputra. All the known Langurs of this group are discussed in this paper. I refer them to two well-defined species, *Pithecus entellus* and *Pithecus senex*, each of which is represented by several local races or subspecies. The colour of the young has not been recorded, so far as I am aware, in the typical form of either of these; but it is known in the subspecies *dussumieri* and *achates*, which are admittedly closely related to typical *entellus*, and in the subspecies *johnii* which is admittedly closely related to typical *senex*.

Group II.—Newly born young, a uniform golden or orange red all over. (Plate I, fig. 1).

This group, which may be called the *Auratus*-group after one of its earliest known species, ranges from Assam, Upper Burma and Siam southwards through the Malay States, Sumatra, Java and Borneo. So far as British India is concerned it is represented by two distinct species, *Pithecus pileatus* found in Assam and other districts near at hand, and *Pithecus auratus* which, as here understood, extends from Upper Chindwin to Southern Tenasserim. Both these species are represented within the British Indian area by several local races.

Group III.—Newly born young parti-coloured, white below, on the sides of the body, the legs and the forepart of the head, but with a blackish or dark brown spinal stripe of varying width extending from the back of the head on to the tail and usually at all events spreading more or less on to the outer side of the arms. (Plate I, fig. 2).

This group I call the *Aygula*-group, from the oldest known species belonging to it. Containing several distinct species and subspecies in Borneo, Java, Sumatra and the Malay Peninsula, this group is more southern in its distribution than the *Auratus*-group and only just enters our area in South Tenasserim where it is represented by *Pithecus femoralis*, a species well known in the Malay Peninsula.



1 2 3

NEWLY-BORN LANGURS

1. The Auratus-Group. *2. The Aygula-Group.* *3. The Entellus-Group.*

My conclusions regarding the numbers of different kinds of Langurs occurring in British India and concerning the importance of the differences between them vary considerably from those of my predecessors. It is needless here to enter into the details of this subject since they are set forth in the following pages; but it must be explained that the divergence of opinion is due mainly to two things. In the first place, I use the word 'species' in a much wider and more comprehensive sense than that adopted by those who determined the langurs collected by the Mammal Survey, a great many of the forms they considered as species being regarded by me as subspecies or local races. In the second place, as compared with the pioneer workers, Blyth, Anderson and Blanford, I have had the advantage of most of the splendid material collected by the Mammal Survey, organized by the Bombay Natural History Society. Where the authors mentioned had only one or two, probably badly preserved skins and a few skulls to guide them, I have had several, in some cases a dozen or more properly prepared, measured and dated skins, from various localities, with skulls to match.

This material has revealed greater individual variation, especially perhaps in the skulls, than was formerly supposed to exist; and it has established the occurrence of a number of local races or subspecies linking forms to which, in the absence, or rather ignorance, of intergrading types, full specific rank was by common consent formerly accorded.

Although the material collected by the Survey has vastly extended our knowledge of the Langurs of British India, it cannot be claimed that it has made easier the task of naming them. It has, indeed, greatly increased the difficulty of constructing analytical keys to facilitate their determination because it has shown the impossibility of assigning definite and constant characters to all the named representatives of this group. There is still much to be learnt about them. Further collections in areas not yet investigated, like the eastern parts of India from Orissa to south of Madras, will almost certainly bring to light new local races and will perhaps show that some of the forms here nominally distinguished are based upon characters not deserving that distinction. For the most part I have had several specimens to guide me; but in others I have been compelled to rely upon a single locally isolated example; and in cases where I have given a name to one or two such examples, it has been to draw especial attention to some particular character of interest, although of doubtful systematic value.

Systematic Account of the Species and Subspecies

The characters of the three groups above described into which the Langur of British India fall may be expressed analytically as follows:—

(*a*)	Newly born young uniformly coloured above and below; never more than one frontal whorl in the hair on the head; nasal bones in the skull not convexly bulging below the brow.	
(*b*)	Newly born young uniformly blackish brown. (Himalayas to Ceylon)	*Entellus*-group.
(*b*^{1})	Newly born young uniformly golden yellow or golden red. (Assam to Tenasserim) ...	*Auratus*-group
(*a*^{1})	Newly born young particoloured, white with a black or brown spinal stripe from the head to the tail tip; a pair of frontal whorls; nasal bones convexly bulging below the brow. (S. Tenasserim)	*Aygula*-group.

I. The Entellus-group.

Characters as set forth above.

The Langurs of this group were referred by Blanford and other authors to six or seven or even more species. But that method of treating them does not express their true affinities. They are very obviously assignable to two categories to which I give specific rank and their characters may be contrasted as follows:—

(*a*)	A single whorl or parting on the forehead behind the brow; hair of the loins not shorter than elsewhere on the back; lower side of the body paler than the upper; skull with prominent brows, the plane of the orbit sloping downwards and backwards from its upper to its lower rim	*entellus*.

(a^1) No whorl on the forehead ; hair on the loins, or croup, shorter than on the back and typically paler ; lower side of the body approximately the same colour as the upper ; skull with less prominent brows, the plane of the orbit sloping downwards and forwards from its upper to its lower rim ... ... *senex*.

1. *Pithecus entellus*, Dufresne.

Simia entellus, Dufresne *Bull. Soc. Phil.*, Paris, i, p. 49, 1797.

It is needless to repeat the distinguishing characters of this species as stated above. It is also needless to quote more than the original reference to the name, because I use the specific title in a much more comprehensive sense than my predecessors to embrace the Langurs assigned by Blyth, Anderson, Blanford and other authors to several distinct species, *schistaceus*, *entellus*, *hypoleucos*, *anchises* and *priam*, all of which, with the possible exception of *anchises*, I regard merely as local races or subspecies of a single species for which *entellus* appears to be the oldest name available.

Distribution. North of the Ganges from Kashmir to Sikkim, possibly to Bhutan, and south of the Ganges from Cutch and Kathiawar to Bengal, thence southwards into northern Ceylon.

KEY TO THE SUBSPECIES OF *P. entellus*

(*a*) Whiskers long and thick, mostly or completely hiding the ears ; head and whiskers uniformly whitish or pale buff and contrasted with tint of back. (N. of Ganges).

(*b*) Coat long, shaggy and mane-like ; arms below elbows black and strongly contrasted with colour of body ... ... *ajax*.

(b^1) Coat shorter, not shaggy and mane-like ; arms and hands not black and not sharply contrasted with colour of body.

(*c*) General colour dark earthy-brown ; coat thick and woolly ... ... *achilles*.

(c^1) General colour paler, slaty or greyish-buff ; coat shorter and less woolly.

(*d*) Skull larger, with prominent nasal region and larger teeth ... ... *hector*.

(d^1) Skull smaller, with less prominent nasal region and smaller teeth ... *schistaceus*.

(a^1) Whiskers shorter, not or only partly hiding ears ; head and whiskers variable but never so white and strongly contrasted as in section (*a*) (S. of Ganges).

(*e*) Hands and feet black and generally sharply contrasted with the arms and legs.

(*f*) Crown of head at most only a little paler than nape and shoulders ; hands and feet black or brown and typically sharply contrasted with arms and legs ... ... *entellus*.

(f^1) Crown of head clearly defined from the shoulders and back by its paler tint.

(*g*) No tuft on crown ; upper portion of whiskers typically clouded with black.

(*h*) Paler ; crown of head uniformly buffish in tint ; tail and outside and inside of legs below knees not black.

(*i*) Arms below elbows not black, contrasted with the hands ... *achates*.

(i^1) Arms below the elbows black, blending with tint of hands.

(j) Paler; cheeks pale like the crown ... .. *dussumieri*.
(j^1) Darker; upper part of cheeks blackish ... *iulus*.
(h^1) Darker; crown of head suffused with dark hairs; tail and outside and inside of leg below knee black.
(k) Not so dark above or below; inner side of thigh clothed with white hairs; size smaller *hypoleucos*.
(k^1) Darker above and below; inner side of thigh mostly clothed with black hairs; size larger ... ... *æneas*.
(g^1) A tuft on the crown; upper portion of whiskers pale like the crown ... *elissa*.
(e^1) Hands and feet not black, practically uniform in colour with the arms and legs.
(l) Crown of head pale, like the cheeks, and contrasted with back; no tuft; size smaller *priamellus*.
(l^1) Crown of head typically darker than cheeks, hardly contrasted with back, and typically tufted; size larger ... *pallipes*.

In the construction of this key, my aim has been the juxtaposition of what appear to be related forms, although it would perhaps have been easier to make a frankly artificial analytical table by the rearrangement of the characters employed. But the actual or probable occurrence of intergrading specimens, it must be remembered, makes the construction of such keys difficult and their use somewhat unsatisfactory. Also it must be remembered that the distinctive features of *dussumieri* and *hypoleucos*, which I have not seen, have been inferred from the descriptions of authors and that the form, also unknown to me, named *anchises* by Blyth, which in the tint of its hands and feet is intermediate between e and e^1, has been omitted.

Subspecies *schistaceus* Hodgson.

Semnopithecus schistaceus, Hodgson, *Journ. As. Soc., Bengal*, ix, p. 1212, 1841.
Semnopithecus nipalensis, *id. ibid.*
Not *Semnopithecus schistaceus* of Blanford, Anderson and other authors, or at least only in part.

Dark slaty above; below and entire head pale yellow; hands and feet somewhat darkened; concolorous. Hair of one sort, more or less wavy. Head and body, 30 inches; tail, 36 inches; hind foot, 8½ inches.
Distribution. Nepal; the Terai Forest.

The description of this race given above is taken from Hodgson's original diagnosis which, as indicated by the measurements, was based in all probability upon an adult male. It is important to remember this because the description cannot be applied to the adult males of any of the Himalayan Langurs in the collection of the British Museum.

This series comprises several examples belonging to Hodgson's collection which are ticketed Nepal. No doubt Hodgson regarded them as specifically identical with the form he described as *schistaceus*; but by no stretch of the imagination can they be described as 'dark slaty above.' They are most emphatically brown, without any perceptible trace of dark, or even light, grey to justify the epithet 'slaty.' Moreover, the available evidence suggests that these brown langurs, as stated below, live at high altitudes in Nepal and possibly Sikkim. There is at all events no evidence that I can find of their occurrence at the relatively low level of the Terai Forest; and this was the opinion of Blanford, who supposed the langurs of the Terai to be typical *entellus* and thus rejected Hodgson's original locality for *schistaceus*.

The only specimen in the British Museum that was shot at a low level in Nepal is a female procured for the Mammal Survey by N. A. Baptista at Hazaria

Pathergatti at an altitude of 300 feet. This has the clearly defined pale head, the yellowish tinted under side and the uniform coloration of the upper side of the body and outside of the limbs described by Hodgson for *schistaceus* and Hinton and Fry[1] identified it as that form, probably quite correctly. It cannot, it is true, be accurately described as 'dark slaty above,' because the tint of the upper side is pale and greyish-buff. The animal, however, is a female giving the following approximate measurements in inches :—Head and Body, 23 ; Tail, 36 ; Hind foot, $7\frac{1}{2}$; Ear, $1\frac{1}{2}$; and since the skull, although the teeth are fully up and even worn, has the occipital suture open, the langur was probably not quite full-sized and might well represent the female of *schistaceus* on the assumption that Hodgson's type of *schistaceus* was a male.

This skull is of particular interest because it is intermediate between the skulls of typical *entellus* of the low levels of Bengal and those of the large langurs described below which inhabit the Himalayas at higher altitudes and have always, but wrongly, been regarded as true *schistaceus*. Its measurements in millimetres are as follows :—Total length, 115 ; length of palate, 41 ; of upper molars, 34 ; width across orbits, 64 ; across zygomata, 82. (Text fig. 4 B.)

It will thus be seen that it is noticeably smaller than the skulls of females of the races from Chamba, Kumaon and Sikkim and has smaller teeth. On the other hand, it hardly differs in these respects from the skulls of some examples of *entellus*, although the face is more sloped and less vertical than in average examples of that race owing to slightly greater prominence of the jaws, but the suborbital area of the face does not recede more than it does in many examples of *entellus*. The brow ridges are prominent and in the middle line rise vertically above the base of the nasals.

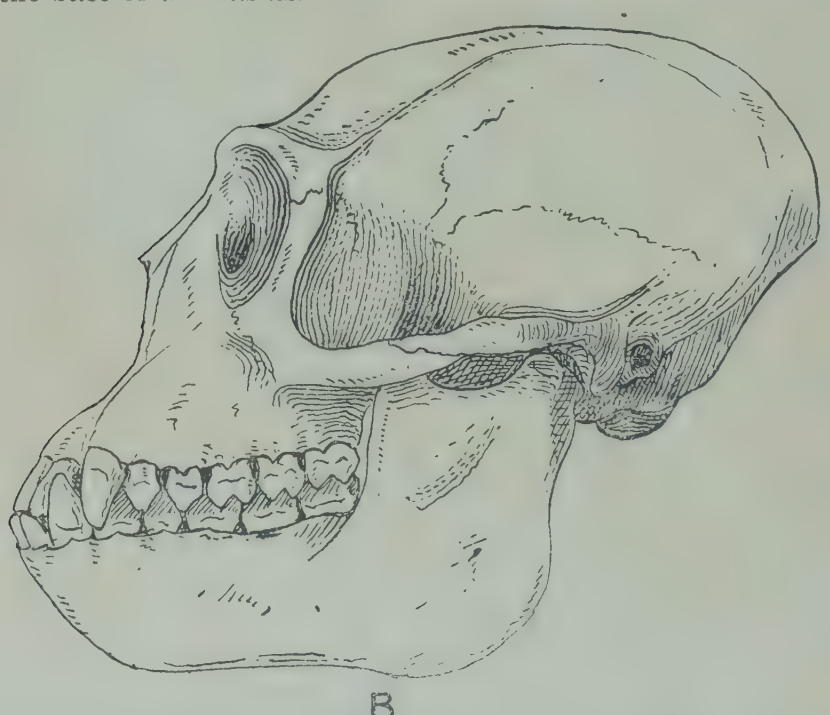


FIG. 4B.—Skull of *Pithecus entellus schistaceus* from Hazaria Pathergatti in the Nepal Terai, ♀ subadult. Two-thirds nat. size.

Subspecies *achilles*, nov.

(Plate II, fig. 2.)

Semnopithecus schistaceus, Anderson, Blanford, Elliot and other authors, at least in part.

Not *S. schistaceus*, Hodgson, 1841 (cf. *supra*).

Distinguishable from *schistaceus* by the nearly uniform chocolate or dusky sepia-brown colour of the upper side of the body, the tail and the outside of the limbs. The upper surface, however, has a paler brown or buff sheen in

[1] *Jour., Bomb. Nat. Hist. Soc.*, vol. xxix, No. 2, p. 404, 1923.



1. THE KANGRA LANGUR (*P. entellus ajax*)
2. THE NEPAL LANGUR (*P. entellus achilles*)
3. THE COMMON LANGUR (*P. entellus entellus*)

reflected light, the tip of the tail is sometimes pale and the hands and feet are sometimes patched with black. Head and nape of neck and whiskers cream or dirty white and contrasted with the brown hue of the shoulders. The lower side and the inner surfaces of the limbs whitish, sometimes tinged with buff.

Coat full, thick and long, but not markedly shaggy, the hairs being tolerably uniform in length and generally more or less wavy especially on the head.

Type. Adult male from the Satthar Hill (12,000 feet) in Gorkha, Nepal.

Distribution. Nepal at high altitudes; and possibly Sikkim.

The only specimen certainly assignable to this race in the British Museum which is labelled with full particulars is the type mentioned above, an adult male shot for the Mammal Survey by N. A. Baptista at an altitude of 12,000 feet on Satthar Hill, Gorkha, about 50 miles north-west of Khatmandu. Its approximate measurements in inches are as follows :—

Head and Body	Tail	Hind Foot	Ear
30	$36\frac{1}{2}$	$8\frac{4}{5}$	$1\frac{3}{4}$

These dimensions correspond tolerably closely with those recorded by Hodgson for *schistaceus* and with those of the males of the local race from Chamba and Kangra described below.

The skull, too, although somewhat flatter along the top, is very like the skulls of that subspecies, as the following dimensions in millimetres show :—

Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
147	57	38	84	108

In addition to the type, the British Museum possesses several skins of this race belonging to Hodgson's collection and ticketed Nepal. These, referred to above under *schistaceus*, have always been regarded as *schistaceus*. No doubt they were considered to be identical with it by Hodgson himself and also by Blanford who saw them. No doubt, too, they are the specimens, or some of the specimens, which induced Blanford to describe *schistaceus* as 'earthy or greyish-brown.' Earthy-brown describes them well; but there is no grey in the pelage of the upper side of the body. Blanford, however, like Anderson, used the title *schistaceus* in a comprehensive sense for all the big langurs living at high altitudes in the Himalayas.

This race may also occur in Sikkim. There is at all events in the British Museum a skin, alleged to have been collected in Sikkim by Mandelli, which is in all important respects like the type and like Hodgson's specimens. Moreover, Elliot's description of *schistaceus* which he said was 'mars brown' above, was taken from a specimen in the Calcutta Museum ticketed Sikkim. And since many of Hodgson's specimens ticketed Nepal came, as Hinton has shown, from Sikkim, Hodgson's examples of *achilles* referred to above, may have come from the latter country.

The available skull material of *achilles* is unfortunately scanty. Setting aside the skull of the type, perhaps the most important is that of a young female belonging to one of Hodgson's specimens. A comparison between this skull and that of the female described above as *schistaceus* is interesting. It is much younger as is shown not only by the distinctness of its sutures but more particularly by the state of its dentition, the upper canine and last upper molar only just appearing above the bone of the jaw, both being probably covered by the gum when the monkey was alive. Nevertheless its measurements in millimetres are as follows :—Total length, 112; length of palate, 40; of upper molar series, 37; width across orbits, 69; across zygomata, 85. Thus it is wider across the eyes and temples, has larger teeth and as long a palate, and

although a trifle shorter owing to the lesser development of the occiput, it would certainly have exceeded the length of the skull of *schistaceus* with growth. The profile too is very different and recalls that of the skull of the female of the race from Kumaon, described below, in the prominence of the nose and the receding brow.

Of Langurs from Kashmir there is very little material in the British Museum, namely two skins only. These, however, appear to be identical with the Nepal form *achilles*. This is perhaps surprising considering the difference between *achilles* and the Langur of Chamba and Kangra described below.

I provisionally refer to *achilles* four skins from Sikkim which are a little paler and greyer than skins from Nepal, but like them in the length and texture of the winter coat. The dimensions of three out of these four female specimens, collected in December and January for the Mammal Survey by Mr. C. A. Crump, are as follows :—

Locality	Head & Body	Tail	Hind foot	Ear	Weight
Chautang, 5,350 ft. ♀	26½"—	33"—	8"—	1¾"	
Lachen, 8,800 ft. ♀	25"	28"—	7½"	1¾"	35 lbs.
Chautang, 5,356 ft. ♀	24"—	30¼"	8"	1¾"	...

The only available adult skull is defective, one side of it having been shot away. It is a little lower in its facial portion than the female skulls of *hector* and *ajax*, but this may be an individual peculiarity because otherwise it is very similar, except that the nasal region is less prominent that in *hector* and like that of the Kangra examples of *ajax*. Its total length is 125 mm., and the upper molar and premolar teeth measure 38 mm.

This is probably the Langur which has previously been recorded from Sikkim as *schistaceus*. But, as stated above, there is in the British Museum a skin labelled Sikkim which was collected by Mandelli and presented by Blanford. But this skin is racially indistinguishable from Nepalese skins of *achilles* ; and since, according to Blanford, Mandelli's localities are not trustworthy, it is not improbable that the skin in question came from Nepal and not from Sikkim. And the same may be said of the example of *achilles* in the Calcutta Museum from Sikkim which Elliot described as *schistaceus*.

A distinguishable Himalayan race closely allied to *P. entellus achilles* has been described and may here be mentioned, although it does not, so far as is known at present, occur within the area of British India.

This is :—

Subspecies *lanius*, Elliot.

Presbytis lania, Elliot, *Ann. Mag. Nat. Hist.* (8), iv, p. 273, 1909 ; *id. Rev. Primates*, iii, p. 93, 1913 (under *Pygathrix*).

Colour very like that of typical *achilles* from Nepal but with a slightly greyer sheen especially on the loins and hind legs, and with more white on the back of the thighs. The coat is a little longer, thicker, softer and more wavy.

Distribution. Chumbi in Tibet, 10,000 feet.

The dimensions in inches of the single female specimen collected by Major F. M. Bailey are as follows :—

Head and body 25 ; hind foot 7½ ; ear 1¾.

The skull, which I have not seen, measures, according to Elliot, 125 mm. in total length, and the zygomatic breadth is 102 mm.

Subspecies *ajax*, nov.

(Plate II, fig. 1.)

Pithecus entellus, Lindsay, *Journ. Bomb. Nat. Hist. Soc.*, xxxi. p. 599, 1926 (not *P. entellus*, Dufresne.)

A big handsome langur as large as *achilles* but differing in the colour and texture of its coat. The general colour of the upper side is dusky brownish-grey, much greyer than in *achilles*, with the whitish cap on the crown typically less distinctly defined owing to a greyish tinge on the nape blending more or

less with that of shoulders; the arms below the elbows and the hands are black or blackish brown in adults and the legs paler greyish-brown, darkened with sooty grey on the thigh and knee in front, the feet at most a little darker than the area below the knee, with the foot bordered externally with white and some white hairs on the toes. The whiskers and throat, the under side of the body, the inside of the limbs and the backs of the thighs, and as much as four inches of the tip of the tail are white.

The coat is loose and shaggy, forming a kind of mane over the shoulders and upper part of the arms and on the flanks, and consisting largely of long greyish white glistening hairs such as are seen in typical *entellus*.

Type. Adult male from Deolah, Chamba, 6,000 feet (H. W. Wells).

Distribution. Northern Punjab; Chamba, from 6,000 to 7,500 feet; Kangra, from 2,450 to 9,500 feet; Kulu, from 9,800 to 11,000 feet.

Young specimens differ considerably from adults in being much paler in colour both on the back and on the arms, and the coat consists of long thick more woolly hair, the coarser glistening hairs of the coat of the adult being practically absent. The examples from Chamba were collected in December and January by H. W. Wells. Those from Kangra, procured in March and April, differ in having the pale cap on the head more clearly defined and in having the arms browner. Three females from Kulu, collected in June, still carry the winter coat but it is very shaggy and wavy. These specimens also have paler arms. Such differences as those observed between the Chamba, Kangra and Kulu individuals are probably seasonal.

The following are the approximate measurements in inches of some selected individuals:—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Chamba, Deolah, 6 000 ft., ♂ ...	30″	38″	9″	2″	..
,, , Bara Tissa, 7,500 ft., ♂ ...	30″	32″	8″	2″	43 lbs.
,, , Chalan Tissa, 6,700 ft., ♂..	30″	33″—	9″	2″	...
Kangra Fort, 2,450 ft. ♂	31″	34½″	8½″	1½″	46 lbs.
,, , Chicaian, 9,000 ft., ♀ ...	27″	28½″	8½″	1½″	28 lbs.
,, , Samyala, 9,500 ft., ♀ ...	23″—	34″	7″	1½″	...
Kangra, 2,400 ft., ♀	24″	33″	7½	1½″	...
Kulu, Rahla 9,800 ft. ♀	21″—	31″	7	1½″	...
,, ,, ,, ,, ♀	20″	30½″	7	1¾	...

The skulls (Text fig. 5A.) do not differ in any important points from those of *achilles*, as represented by the one from Gorkha and the fragments of those collected by Hodgson referred to above. The following table shows their dimensions in millimetres:—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
Chamba, ♂ ...	147	57	41	84	111
,, , ♂ ...	145	54	40	82	111
,, , ♂ ...	141	54	40	84	109
Kangra, ♂ ...	144	54	41	84	109
,, , ♀ ...	124	46	40	72	94
,, , ♀ ...	120	43	40	73	94

Subspecies *hector*, nov.

Presbytis schistaceus, Wroughton, *Journ. Bom. Nat. Hist. Soc.*, xxiii, p. 286, 1914 (not *P. schistaceus*, Hodgson).

Approximately the same size as *achilles* and *ajax* but differing from both in colour and in the shortness of the hairs of the winter coat. General

colour slaty-grey tinged with buff or pale brown ; the outside of the arms grey below the elbow and a little darker than the back, but not nearly so dark as in *ajax* ; the outside of the legs paler than the back and with a sooty grey tint on the thigh in front. The white cap on the head and nape sharply defined and the under side either dirty white or more frequently suffused with buff or pale red. The winter coat consisting of hairs of tolerably uniform length, shorter than in *achilles* and not so thick and very much shorter than in *ajax*.

Type. Male (skin and skull) from Sitabani, Ramnagar, Kumaon, 2,000 feet. B. M. No. 14.7.10.10.

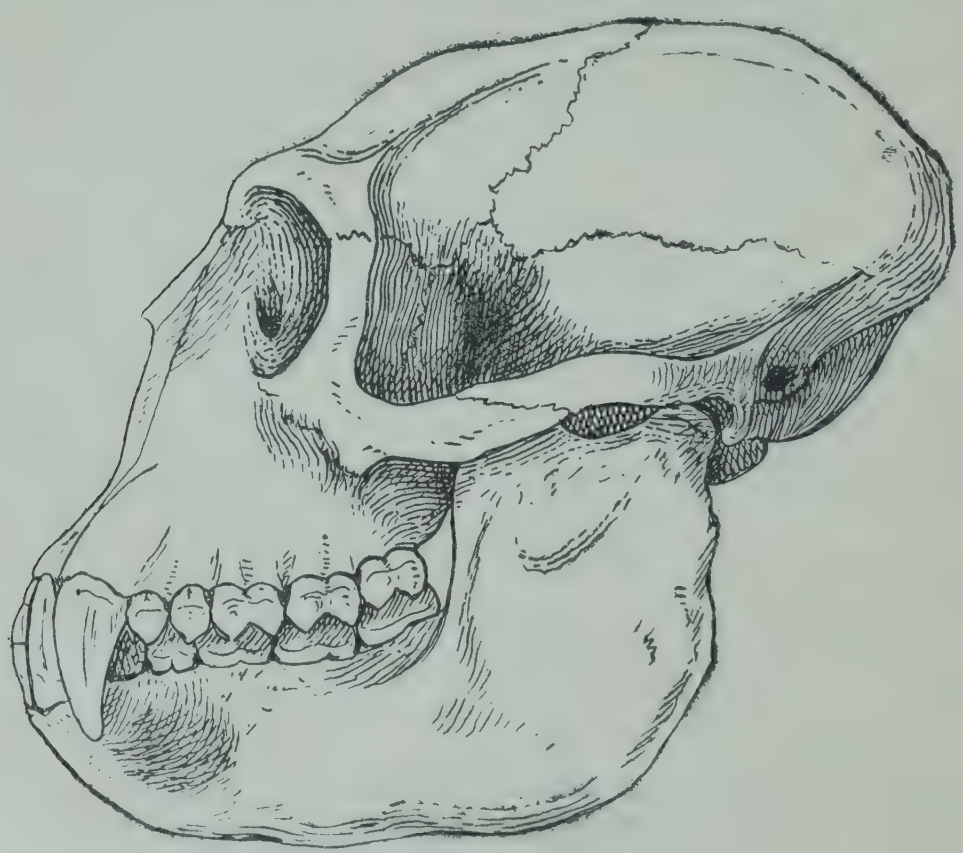
Distribution. Kumaon up to 6,000 feet.

In general coloration the known examples of this race closely resemble the specimen of *schistaceus* from Hazara Patherghatta described above. The skulls of adult females of the two are, however, different in dimensions and shape, those of *hector* being larger, with bigger teeth, less pronounced brows and more prominent nose. But additional specimens from the Terai Forest may prove *hector* to be identical with *schistaceus*, if the skulls are found to intergrade.

The following table gives the approximate dimensions in inches of the skins of this langur shot by C. A. Crump in November, January and February :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Champawat, Almora, 6,000 ft., ♂ ...	27½+	39	9+	2 —	...
Sitabani, Ramnagar 2,000 ft., ♂ ...	26	37	8½+	2 —	38 lbs.
Dela, Ramnagar, 1,500 ft., ♀ ...	24+	33½—	7½+	1½	39 lbs.
Ratighat, Naini Tal, 3,700 ft., ♀ ...	23½+	33	8	2 —	31 lbs.

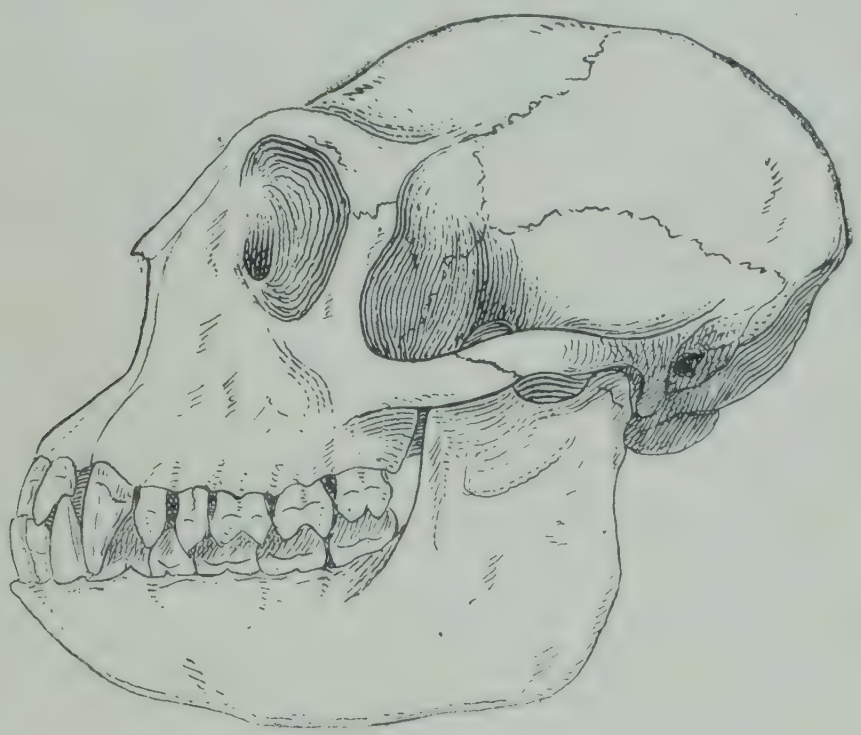
The two males, it will be seen, are a little smaller than the adults from Chamba ; but the skulls show them to be rather younger animals.



A

FIG. 5A.—Skull of *Pithecus entellus ajax* from Chamba, ♂ ad. Two-thirds nat. size.

The skulls generally resemble those of *achilles* and *ajax*, but have the nose more prominent. This is particularly noticeable in the skulls of two adult females when compared with the skulls of adult females of *ajax* from Kangra. It is also observable in two male skulls. These also are narrower than the skulls of adult males of *ajax* ; but they are younger, the basioccipital suture being still open. Their youth, no doubt, accounts for their narrowness ; and probably increase in the size of the brow ridges with advance of years would lessen the appearance of prominence of the nose. (Text fig. 4A.)



A

FIG. 4A.—Skull of *Pithecus entellus hector* from Naini Tal. ♀ ad. Two-thirds nat. size.

The dimensions in millimetres of four skulls are as follows :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
Ramnagar ♂ ...	135	50	3	77	96
,, ♂ ...	132	49	40	75	98
Naini Tal ♀ ...	123	46	40	70	94
Ramnagar ♀ ...	119	46	41	70	90

Several skulls of adult males from Garhwal, presented to the British Museum by B. B. Osmaston, may, for geographical reasons, be provisionally assigned to this race ; but unfortunately there are no skins from this district of Kumaon by which the correctness of this inference can be tested. These skulls do not differ appreciably from those of *achilles* and *ajax*.

The Langurs recorded by Blyth on Hutton's authority as occurring in Mussoorie and Simla up to 11,000 feet and described by Hutton as dark greyish with pale hands and feet and white head, throat breast and tail-tip, certainly differ from *ajax* from Chamba, but appear to agree very closely with this Kumaon race, *hector* ; and a number of skulls of adult males presented by Hutton to the British Museum, which may have been procured by him either at Simla or Mussoorie, are not distinguishable from the skulls of adult males of *ajax* and *achilles*. Nevertheless, as stated above, the skulls of adult females of *hector* from Kumaon have, owing to the prominence of the nose, a different appearance from adult female skulls of *ajax*.

Subspecies *entellus*, Dufresne.

(Plate II, fig. 3.)

Simia entellus, Dufresne, *Bull. Soc. Phil.*, Paris, 1, p. 49, 1797.
Semnopithecus or *Presbytis entellus* of Blyth, Anderson, Blanford, etc : and of Dollman, *Journ., Bom. Nat. Hist. Soc.*, xxii, No. 3, p. 438, 1913.

Smaller than the Himalayan races and distinguishable from them by the uniform coloration of the head and shoulders and by the sharp contrast between the black or brown and black hands and feet and the grey of the arms and legs below the elbows and knee. General colour of upper side darker or lighter shining sepia brown, becoming paler on the shoulders and head. Outer side of arms to, or almost to, the wrists and of the legs down to, and often including, part of the foot, much the same tint as the back, as also is the greater part of the tail ; but the leg below the knee is generally paler and greyer and the end of the tail is usually nearly white. The whiskers, which do not conceal the ears, the throat, the chest, the belly, the inside of the limbs and the back of the thighs whitish or buffy-white.

Distribution. Northern parts of peninsular India south of the Ganges from Bengal westwards to Kathiawar and Guzerat.

The Mammal Survey secured a useful series of this langur from various localities ranging from Bengal, whence the original example came, westwards to Kathiawar and Guzerat. I have been unable definitely to establish the existence of local races over the whole of this area which is probably tolerably uniform in its physical features ; but the series of skins as a whole shows that *entellus* is not nearly so sharply differentiated as is suggested by the writings of Blanford and other authors. Blanford, for instance, following Blyth and Anderson, lays great stress upon the uniform tint of the head and shoulders, involving the absence of a distinct pale cap on the crown, and the sharp contrast between the blackness of the hands and feet and the paler tint of the arms and legs. Both these features are, however, variable. In a series from Midnapore (200 feet), for example, the head is paler than the shoulders, but the tints blend on the nape ; the hands and the feet are black in adult males but brown with black fingers and toes in a young male and adult females. Similar variation with age in the tints of the extremities is seen in other specimens. A female from Junagadh in Kathiawar is darker above than the Midnapore examples but has the feet grey with black toes and the hands and wrists black ; and a female from Deesa in Palanpur is paler than the Midnapore series but this langur was shot in May when it was apparently still carrying its shaggy winter coat.

The following are the approximate dimensions in inches and the weights of a few specimens picked haphazard :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Hazaribagh, 1,000 ft., ♂	25½	42½	8¼	2	...
Midnapore, 200 ft., ♂ ...	25	44	8½	1¾	35 lbs.
Hoshangabad, 3,300 ft., ♂ ...	25	42½	8½	2	..
Chikalda, Berar, 366 ft., ♂ ...	23½	42	8½	...	...
Junagadh, Kathiawar, 200 ft., ♂ ...	23	37½	7½	1¾	...
Seonbadoh, Berar, 1,800 ft., ♀ ...	25	37½	7¾	1¾	...
Midnapore, 200 ft., ♀	22½	38	7	1½	25 lbs.
Deesa, Palanpur, ♀	21½	35	7¼	1¾	...

These measurements bear out the statement made above regarding the comparative dimensions of *entellus* and the related langurs to the north of the Ganges. In connection with Blanford's statement that the ears of *entellus* are larger than those of *schistaceus*, it must be remembered that he was unacquainted with *schistaceus* in the restricted sense in which that term is used in this paper. The ears on dried skins of *entellus* look larger mainly because they are not concealed to the same extent by the whiskers. Nevertheless they are on the average a little larger than the ears of the races from the high Himalayas.

The skulls vary greatly in shape. Blanford's statement that the skull differs from that of the mountain forms he took for *schistaceus* in having the nose not projecting beyond a straight line tangential to the middle of the brows and the alveolar border of the incisor teeth is not true. In two female skulls from Hewra in Rewa and Seoni, Malwa in the Central Provinces, the nose projects beyond that line. Similar variation in the shape of the cranial portion may be seen by a comparison between the figure of an adult male skull of *entellus* published by Blanford where the upper surface is low and flat, with a very long and projecting occipital region, and the skull of the adult male from Hazaribagh which is more steeply sloped. Of particular which is interest is the skull of an adult male from Deesa in Palanpur, which in its low facial portion recalls the skull of the South Indian and Ceylonese race formerly known as *priam* and described below as *pallipes*. Nevertheless, as Anderson pointed out, the skulls of *entellus* certainly differ on the whole from those of the northern mountain races in having the line of the face more vertical with the nose and jaws less prominent. It also is a little smaller and has smaller teeth. But, as stated above, these differences will in all probability be found to break down when more is known of true *schistaceus* from the Nepal Terai. (Text figs. 5B, 6A, 6B, 7A and 9A.)

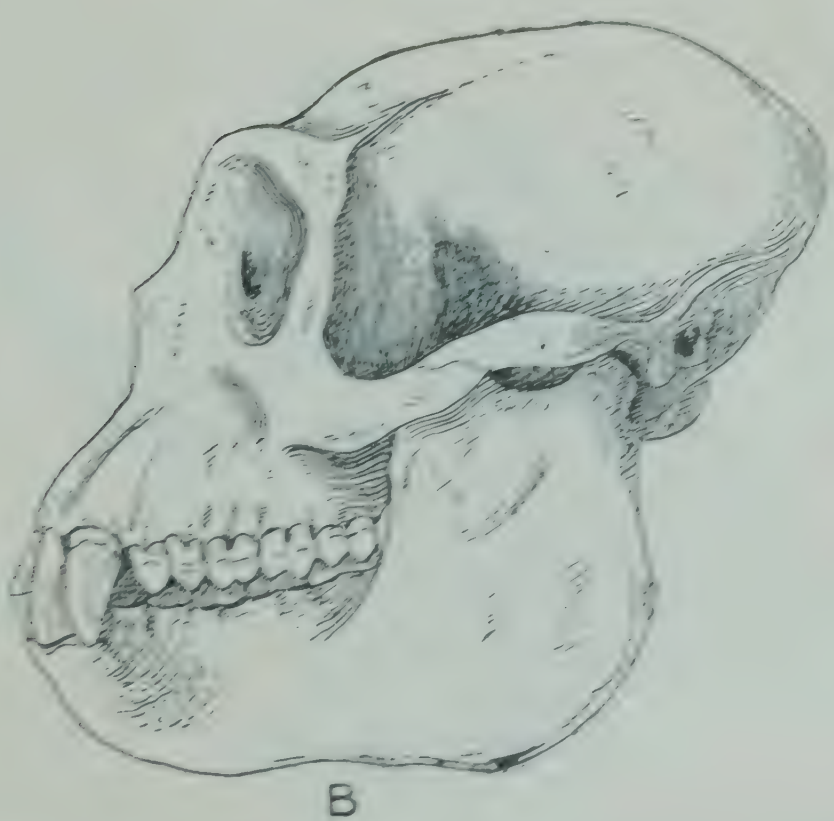


FIG. 5B.—Skull of *Pithecus entellus entellus* from Hazaribagh, ♂ ad. Two-thirds nat. size.

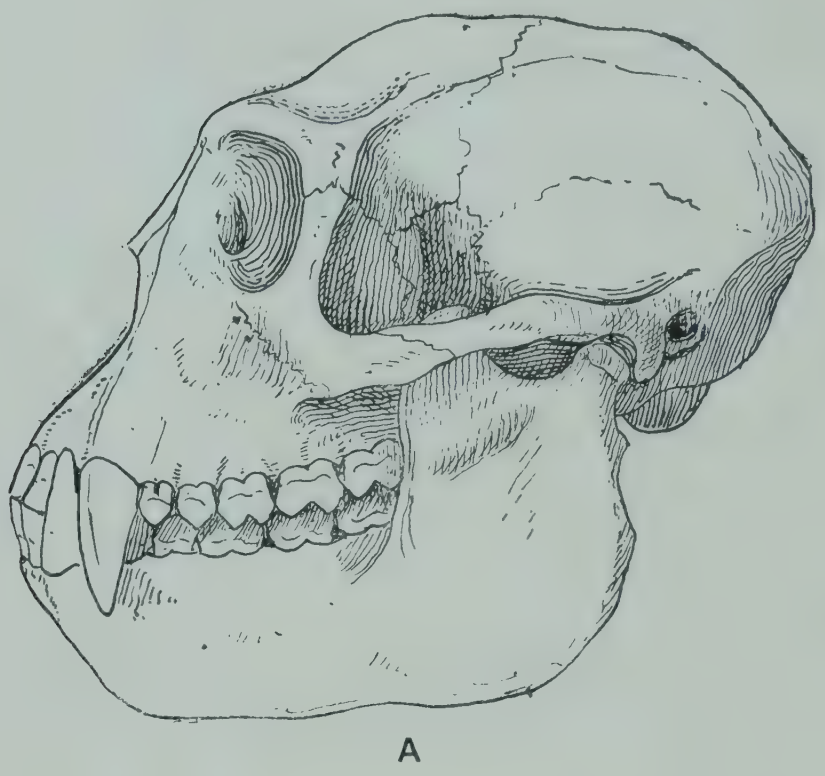


FIG. 6A.—Skull of *Pithecus entellus entellus* from Midnapore. ♀ subadult
Two-thirds nat. size.

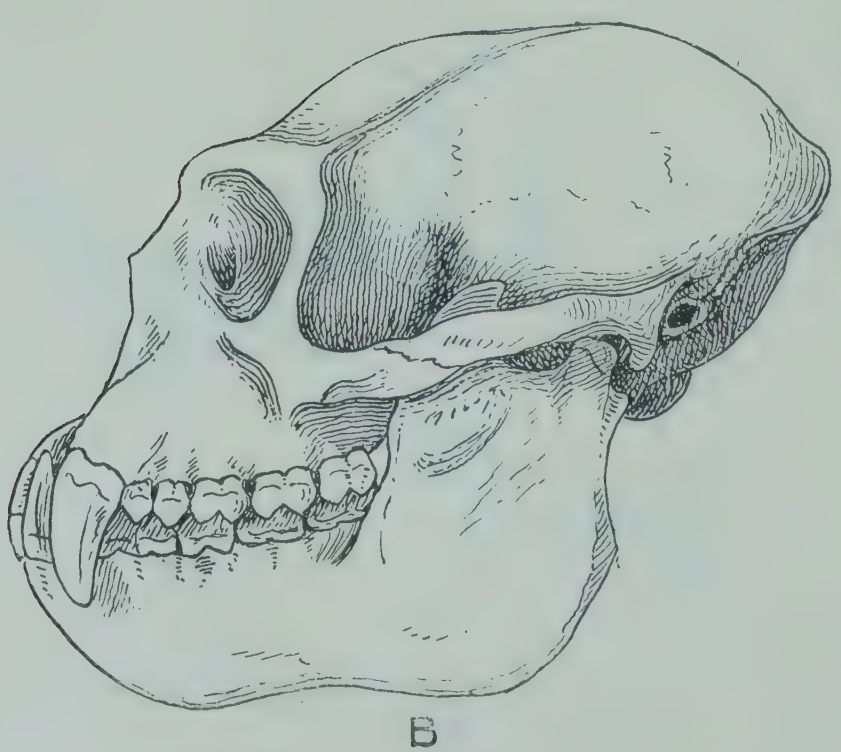


FIG. 6B.—Skull of *Pithecus entellus entellus* from Palanpur. ♂ ad.
Two-thirds nat. size.



FIG. 7A.—Skull of *Pithecus entellus entellus* from Hoshangabad. ♀ ad. Two-thirds nat. size.



FIG 9A.—Skull of *Pithecus entellus entellus* from Midnapore, ♂ subadult. Two-thirds nat. size.

The following are the measurements in millimetres of some of the specimens :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
Hazaribagh, ♂ ...	131	51	34	82	106
,, ♂	128	47	36	78	102
Bengal, ♂ ...	128	46	37	81	104
Deesa, ♂ ...	127	42	36	81	103
Midnapore, ♂ ...	123	46	36	84	92
Chikalda, ♂ ...	120	42	33	75	98
Junagadh, Kathiawar, ♂ ...	120	42	35	73	91
Midnapore, ♀ ...	110	36	34	67	89
Hoshangabad, ♀ ...	109	37	35	65	87
Junagadh, ♀ ...	106	37	33	72	88

With the exception of the second and third on the list, which were presented to the British Museum by Mr. W. Theobald, these skulls were collected by the Mammal Survey. The male examples from Midnapore and Junagadh are not quite fully developed.

Blyth (*Journ., As. Soc., Bengal*, xiii, p. 470, 1844 and xvi, p. 733, 1847) gave the name *anchises* to the skin of a Langur, from an unknown locality in the Deccan, which he described as like the darkest examples of *entellus* but with the hands mixed white and blackish, the feet whitish with dusky black above the base of the toes and on the terminal phalanges and the leg from the knee whitish. Coat generally much longer, the hair from 4 to 6 inches on the sides of the body and not wavy as in *entellus* ; the toes having long hairs like those of a spaniel's paw.

Out of the very large number of *entellus* and *entellus*-like langurs in the British Museum procured by the Mammal Survey in India to the south of the Ganges, there is not one that exactly fits the description of *anchises*. Nearest to it comes a female, collected in November at Hewra (1,000 feet) in Nimar. This resembles *entellus* in the uniform tint of the head and shoulders ; but the coat, as in *anchises*, is long, there are longish hairs on the toes and the feet are much paler, being grey, like the leg, with some black hairs on the knuckles. The hands, however, are not so pale as in the type of *anchises* ; they are distinctly brown, that tint blending with the colour of the arm, and have black hair on the knuckles.

Very like this example from Nimar is one obtained by Mr. Prater at Lahi, Seone Malwa, in the Central Provinces ; but the hands and feet are a little darker ; and a second specimen from the same locality is still blacker on its extremities and is hardly different from *entellus* in that respect, but the head is paler than the shoulders as in the more southern races below recorded.

These specimens, with the type of *anchises*, are peculiarly interesting because they show a complete gradation in the colours of the hands and feet between *entellus* and the *entellus*-like form from Southern India and Ceylon usually cited as *priam* or *priamus* which is described below under the name *pallipes*. And the specimen with the darkest hands and feet and the paler head similarly reveals a gradation between *entellus* proper and the race next described.

The exact status of *anchises* must for the present be left unsettled. It may represent a distinct subspecies. At all events on the available evidence it cannot be assigned to typical *entellus* ; and equally certainly it cannot be regarded as identical, as Blyth supposed, with the black-footed, black-handed forms of southern India. Conceivably it may represent a variety or sport of either.

Subspecies *achates*, nov.

Semnopithecus anchises var. Blyth, *Journ. As. Soc., Bengal*, xiii, p 471, 1844.
Presbytis entellus anchises, Dollman, *Journ. Bom. Nat. Hist. Soc.*, xxii, No. 3, p. 442, 1913. Not typical *S. anchises*, (cf. *supra.*)
Semnopithecus hypoleucus, Blanford, at least in part. Not *S. hypoleucos*, Blyth.

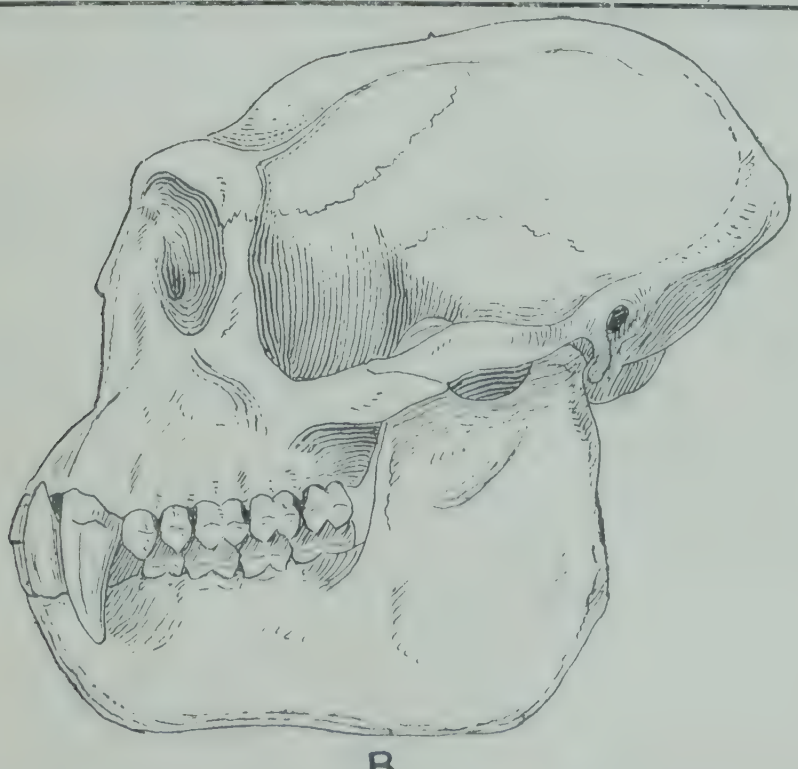
Closely related to typical *entellus* and intergrading with it, but with the buff or greyish-buff coloured crown of the head paler than the shoulders and differentiated in tint, although not so sharply differentiated as in the races to the north of the Ganges. Its hair also is more woolly. The general tint of the dorsal surface is on the average somewhat darker, the upper part of the cheek between the eye and the ear is tinged with blackish-grey and the black of the hands and feet is not so defined from the tint of the arms and legs owing to the somewhat darker hue of the lower half of these limbs, especially of the legs below the knees.

Distribution. Bellary, Dharwar and Kanara, from 1,500 to 2,000 feet in the Western Ghats; also Karwar, on the sea coast, to the west of the Ghats.

Type. Adult ♂ from Hausbavi, 2,000 feet, S.W. of Dharwar. B. M. No. 14.11.18.1.

The following are the measurements and weights of some of the specimens collected by Mr. Shortridge for the Mammal Survey :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Vijayanagar, Bellary, 1,600 ft., ♂ ...	26½″—	40″	8½″+	2″+	35 lbs.
Hausbavi, S. Dharwar, 2,000 ft. ♂...	27″—	43″+	8″	2″—	30 lbs.
Devikop, 26 miles S. of Dharwar, 2,000 ft., ♂ ...	26½″	39½″	7½″	2″—	...
,, ♂ ...	26″	38″	7½″	2″—	...
Samasgi, Kanara boundary, S. W. Dharwar, 2,000 ft., ♂ ...	24″	34″	7″	1½″	22¾ lbs.
,, ,, ♂ ...	24″	34″	7″	1½″	19½ lbs.
Vijayanagar, Bellary, 1,500 ft., ♀ ...	26″	35″	7½″—	2″	27 lbs.
Alnavar, Dharwar, ♀	26″	34½″	7½″+	2″—	...
Devikop, 26 miles S. of Dharwar 2,000 ft., ♀ ...	25″	37½″	7½″	2″—	...
Hausbavi, S. Dharwar, ♀ ...	24½″—	33″	7″	1¾″	22½ lbs.
Samasgi, Kanara boundary, S. W. Dharwar, 2,000 ft., ♀ ...	22½″—	31½″	6½″	1½″	17 lbs.



B

FIG. 7B.—Skull of *Pithecus entellus achates* from Hausbavi. ♂ ad. Two-thirds nat. size.

Three examples collected at Potoli, N. Kanara (1,800 feet) are interesting. Two of them resemble typical *achates* in colour ; but the third is darker, as dark as the two examples from Jog described below, and is in this respect a transitional specimen between the two races.

From Blyth's original description of *anchises* it is clear that he knew by hearsay from Elliot of the existence of *entellus*-like langurs to the south of the range of typical *entellus*. Although he did not know the exact locality of his type of *anchises*, he stated that that form represented *entellus* in the Deccan and along the foot of the Western Ghats. He also had a specimen from Coimbatore which he regarded as a probable variety of *anchises* from which it differed by having black hands and feet as in *entellus*. This langur no doubt belonged to the race here described as *achates*. It was probably Blyth's statement regarding the distribution of *anchises*, and not his description of it, that induced Dollman to identify as *anchises* the langurs here described as a new subspecies.

The skulls (Text fig. 7B) in form and also in individual variability are very like those of typical *entellus*, but are smaller, with a more vertical face, shorter jaws and smaller teeth. The measurements in millimetres of a few of them are as follows :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
Hausbavi, ♂ ...	118	41	32	74	93
Samasgi, ♂ ...	116	37	30	66	87
Potoli, N. Kanara, ♂	112	40	34	70	91
Devikop, ♂ ...	112	38	32	70	—
Vijayanagar, ♀ ...	110	38	33	69	89
Alnavar, ♀ ...	110	39	31	68	84
Samasgi, ♀ ...	102	32	30	65	81
Karwar, ♀ ...	100	34	31	61	82

These measurements show that whereas the skulls of the males are on the average distinctly smaller than those of *entellus*, the skulls of the females are quite as big. The sexual difference, therefore, in *achates* is much less than in *entellus*. Since moreover, the body measurements of the males attest approximake equality in size between the males of *achates* and *entellus*, it is evident that the males of *achates* have a relatively much smaller head.

Subspecies *iulus*, nov.

Resembling and intergrading with *P. entellus achates*, but smaller and with closer, softer, less shaggy hair, and darker in tint, the back being deep brown, against which the pale buff coloured head shows up conspicuously. Cheeks with a considerable quantity of black hair between the eye and the ear, as in *achates*. Arms in the male black from the elbow outside, a little paler in the female. Legs deep greyish-brown outside. Tail blackish-brown with the terminal third whitish. Lower surface and inside of arms and legs pale as in *achates*.

Distribution. Jog, Gersoppa Falls on the Kanara-Mysore Boundary, 1,300 feet. (G. C. Shortridge).

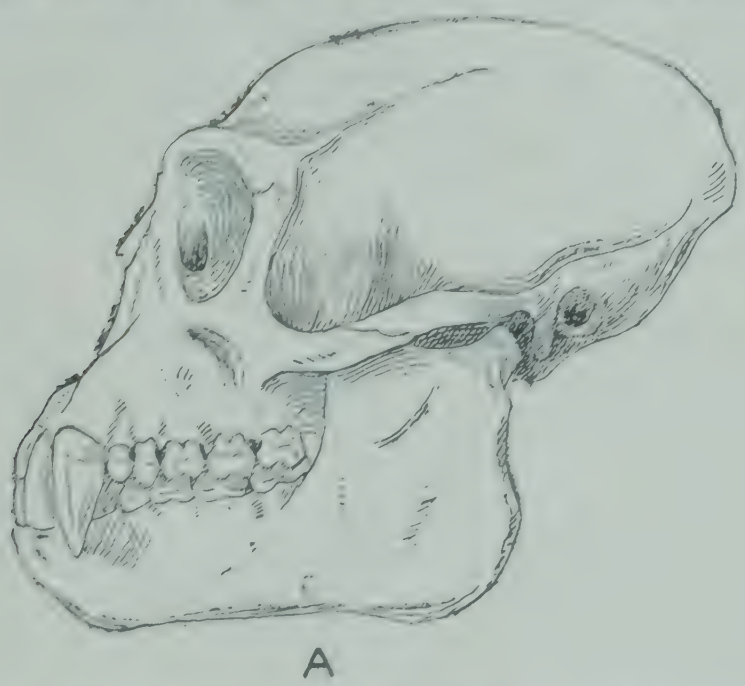
Type. ♂, B.M. No. 14.11.18.7.

The two adult examples collected at this locality give the following approximate measurements in inches :—

Sex	Hand and Body	Tail	Hind Foot	Ear	Weight
♂	20½″+	34″	6½″+	1¾″	21 lbs.
♀	20″+	36″	6¾″	1¾″	18½ ,,

Except for the conspicuous paleness of the head, this langur much resembles the race, *hypoleucos*, in the darkness of the back, the black tint of the arms

and the proximal two-thirds of the tail; but in the paleness of the head, of the tip of the tail, the grey hue of the outer side of the legs and the absence of the blackness from the inner sides of the arms and legs it is like typical *achates*. And the interest of the specimens lies in the link they form in the chain between *hypoleucos* and *entellus*. (Text fig. 8A) hitherto regarded as well-defined species.



A

FIG. 8A.—Skull of *Pithecus entellus iulus* from Jog in Kanara. ♂ ad. Two-thirds nat. size.

The skulls measure, in millimetres, as follows :—

Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
♂	106	35	30	65	84
♀	103	36	31	63	85

Judging from the somewhat scanty material, there is scarcely any difference in size between the male and female of this race.

Subspecies *dussumieri*, Geoffr.

Semnopithecus dussumieri, I. Geoffroy, *C. R. Acad. Sci.*, xv, p. 719, 1842, and *Arch. Mus.*, ii, p. 538, pl. xxx, 1843.

Back greyish-brown; crown of head, cheeks, neck and flanks yellowish; outer surface of arm to the elbow a little darker than the back, from the elbow to the finger-tips black; outer surface of legs to the ankle a little darker than the back, feet black; tail black turning to greyish-brown in the terminal third; under side and inside of limbs yellowish.

Distribution. Coast of Malabar.

Since the single known example of this langur was collected by a Frenchman, it probably came from Mahé, the French Colony in Malabar.

No langurs quite resembling this race, as described and figured, were collected by the Survey, those most like it being the specimens referred to *achates* and *iulus*. The latter, indeed, so far as it is possible to judge, only differs from *dussumieri* in being much darker on the back, which cannot be described as greyish-brown, and in having the upper part of the cheek or whiskers between the eye and ear washed with black pigment. Otherwise they appear to resemble one another in colour, particularly in the blackness of the arm below the elbow. Close resemblance to *dussumieri* is also shown by *achates*, but in

the latter the arm below the elbow is not black, being noticeably paler than the hand, the upper part of the cheek is dark and the basal two-thirds of the tail is not black. It may be added that *dussumieri* differs from *hypoleucos* in being much paler above and in having the area of the leg below the knee about the same tint as the back and not black. Yet in spite of these obvious differences between the description of *dussumieri* and the type of *hypoleucos*, which he had in his hands and described, Anderson quoted *dussumieri* as an unquestionable synonym of *hypoleucos*. Naturally his description of *hypoleucos* does not fit *dussumieri*. Blanford, on the other hand, gave a description of *hypoleucos* which fits *dussumieri*, but not the type of *hypoleucos*. Finally, Elliot's statement that the type of *dussumieri*, which he saw in the Paris Museum, agrees with his description of an apparently accurately determined specimen of *hypoleucos* from Travancore must be untrue, if any reliance is to be placed on Geoffroy's description and figure of *dussumieri*.

Subspecies *hypoleucos*, Blyth.

Semnopithecus hypoleucos, Blyth., *Journ. As. Soc., Bengal*, x, p. 839, 1841 ; also xiii, p. 470, 1844 ; and xvi, p. 733, pl. xxvi, fig. 1, 1847 (*Presbytis*). Anderson, *Zool. Res. Yunnan*, p. 20, 1878. Not *S. hypoleucos*, Blanford, *Mamm. Brit. India*, p. 33, 1888, or at least only in part.

Back and shoulders deep dusky brown, head and whiskers brownish-white, a little darker on crown ; outer surface of arms to elbows and of legs to knees the same colour as the back but arms below the elbows and legs below the knees, including the hands and feet, black ; tail also black. Sides and lower surface of body, inner side of arms to elbows and of legs to knees white ; arms below elbows and legs below knees mostly black with some whitish hairs on the arms and on the front of the leg.

Distribution. Travancore.

No langurs exactly fitting this description, which is taken from Blyth's original diagnosis, were collected by the Mammal Survey. Blyth had one skin of an old male said to have come from Travancore and the dimensions he gave of the head and body, 21 inches, and of the tail, 32 inches, are probably only approximately correct. Nevertheless, Anderson, who extracted the skull from Blyth's type, stated that its total length is 106 mm., and since this type was an old male, it is clear that *hypoleucos* is a small race closely resembing in that particular the race from Jog described as *iulus*. It is also evidently very like *iulus* in colour especially in the blackness of the outer side of the arm below the elbow ; but it differs from *iulus* in having the legs below the knees black outside and inside, with apparently more black on the inside of the arm below the elbow and a somewhat darker head.

Subspecies *æneas*, nov.

Evidently tolerably closely resembling *hypoleucos* but a larger and more heavily pigmented form. Back dark brown ; the top of the head much darker than in *achates*, *iulus* and *priamellus* and not nearly so sharply contrasted with the shoulders but passing into reddish-buff in front. Arms very dark, deep brown close up to the body but black in front on the shoulder and from above the elbow to the finger-tips on the inner as well as on the outer side. Outer surface of legs like the arms, brown close to the hip but black in front and from above the knee to the tips of the toes, black also on the inner side up to the pubic region. Tail blackish throughout. Whiskers, throat, flanks and lower surface buffy or reddish-white, this hue also extending along the inner surface of the upper arm and obscurely down the middle of the pubic area between the thighs.

Distribution. S. Coorg from Makut, below the Ghats, 250 feet, to Wottekolli, 2,000 feet (G. C. Shortridge).

Type. Adult male from Makut, B.M. No. 14.11.18.23.

The description given above was taken from a sub-adult male from Makut and an adult female from Wottekolli. They resemble *hypoleucos* in general coloration but certainly differ from it in the blackness of the hairs on the inner side of the thigh making a sharp contrast with the white of the belly. A young male with the head and body 24 inches and the tail 32 inches is not so heavily pigmented on the limbs and in this respect comes nearer *hypoleucos*. The head of *æneas* also seems to be considerably darker than in *hypoleucos* ; and the only

known example of the latter, an old male, is considerably smaller than the adult male of *æneas* as the following measurements show :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Makut, 250 ft., ♂	28″	37″	7″	1½″	25½ lbs.
Wottekolli, 2,000 ft., ♀	25″	36″	6½″	1½″	22 lbs.

The skulls of these two adult examples measure, in millimetres, as follows :—

Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
♂	112	40	32	68	...
♀	106	38	32	66	86

It seems singular that two races of *Pithecus entellus* should occur in Coorg, namely, *elissa* at Nagarhole in the south-eastern part of the province and *æneas* at Makut and Wottekolli in the southern part, and both at nearly the same elevation. Nevertheless the two are readily distinguishable by their colour and it seems probable that *æneas* inhabits a zone with much heavier rainfall than *elissa*.

Subspecies *elissa*, nov.

Presbytis entellus anchises. Dollman, *Journ. Bomb. Nat. Hist. Soc.*, xxii, p. 494, 1913. Not *anchises*, Blyth.

Indistinguishable in general colour from some examples assigned to *achates* and no two of the four specimens examined exactly alike. But differing apparently from *achates* in having somewhat softer, silkier hair, a distinct tuft or crest on the crown of the head and in the uniformly white or whitish-tint of the cheeks, the dusky hue between the eye and the ear, present in *achates* and *iulus*, being absent.

Distribution. Nagarhole, S. E. Coorg (2,600 feet).

Type. Adult ♀, B. M. No. 14.11.18.16.

The chief interest of this form lies in the presence of the crest or tuft on the crown of the head, which was noticed by Mr. Shortridge, the collector, and is apparent on all the skins. A similar crest has hitherto been regarded, so far as the Indian and Ceylonese langurs are concerned, as distinctive of the race described below as *pallipes* and generally known as *priam* or *priamus*. I do not attach very much importance to this crest as distinguishing *elissa* from *achates* ; but its development in *elissa* unquestionably lessens the systematic value that has been attached to the development of a similar crest in *pallipes* and it is worthy of special attention on that account alone.

The measurements in inches and the weight of two adult females and of an immature male are as follows :—

Sex	Head and Body	Tail	Hind foot	Ear	Weight
♂	24″	36″	7⅓″	1½″	20 lbs.
♀	25″	36½″	7″	1½″	23 lbs.
♀	24½″	31½″	6½″+	1½″	18¼ lbs.

The following are the dimensions of the skulls of the same specimens :—

Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
♂	105	35	32	63	...
♀	103	36	33	67	79
♀	99	34	30	65	81

In the skull of the male the canine and the last molar, although through the bone, are only half up ; and since it may be assumed that the monkey was not full sized, the conclusion that *elissa* is about equal to *achates* in size is justifiable.

Subspecies *priamellus*, nov.

Colour of upper side sepia brown, similar to that of *achates*, but with the head and cheeks dirty white, without any dark pigment on the cheeks between the eye and ear, with the outer side of the arms and legs uniformly brown, about the same tint as the back, this colour blending with that of the hands which are not black and only slightly darker than the arm, while the feet are greyish-brown and the same colour as the leg below the knee, the tail being the same colour as the back with its terminal portion whitish. The back of the thighs, the whole of the underside of the body and the inside of the limbs clothed with white hairs.

Distribution. Shernelly in Cochin.

Type. Adult male, collected for the Survey by Mr. Riley O'Brien. B. M. No. 21.11.5.7.

One specimen only was obtained and no measurements were recorded.

The chief interest of this specimen lies in the resemblance it shows to *achates* and *pallipes*. It approaches *achates* in the paleness of the head as compared with the back but differs in the absence of blackness from the hands and feet, and it resembles *pallipes* in the hands and feet being the same tint as the arm, and legs but differs in the colouring of the head. There is also no trace of a crest on the head.

The skull has prominent brows and the interorbital nasal region is concave, being vertical above and projecting below at an angle of about 135°; but the most noticeable peculiarity about the skull is the shape of the nasal orifice which instead of being long and narrow, as is typically the case in the other races of *entellus*, is wide, the width considerably exceeding half the greatest height. (Text figs. 8B and 9B.)

The dimensions of the skull are as follows :—

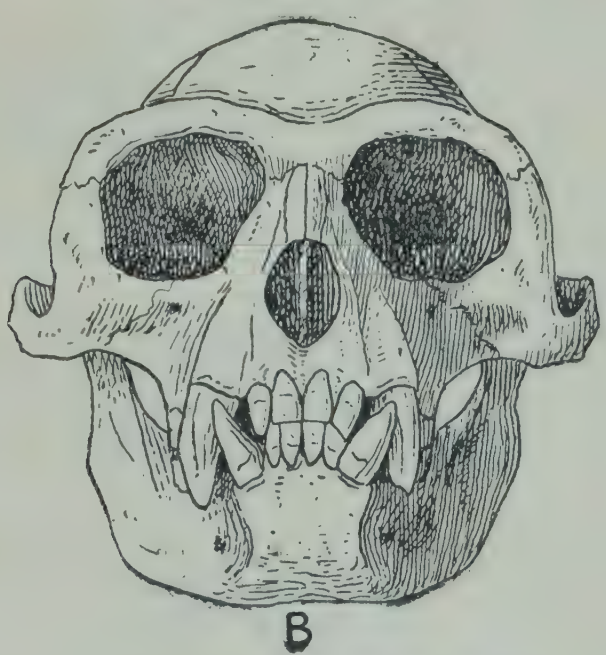
Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
105	38	31 +	69	82

Since the skull attests the full maturity of the specimen, it is clear that this race of langur is much smaller than *pallipes*, considerably smaller than *achates* and as large only as *iulus* ; but from the structure of the skull and the colour of the hands and feet I am disposed to think this langur is more nearly related to *pallipes* than to *achates* or *iulus*.



B

FIG. 8B.—Skull of *Pithecus entellus priamellus* from Cochin. ♂ ad. Two-thirds nat. size.



B

FIG. 9B.—Skull of *Pithecus entellus priamellus* from Cochin. ♂ ad. Two-thirds nat. size.

Subspecies *pallipes*, Blyth.

Semnopithecus pallipes, Blyth, *Ann. Mag. Nat. Hist.*, p. 312, 1844 (April).
Semnopithecus priam, Blyth, *Journ. As. Soc., Bengal*, xiii, pp. 470 and 476, 1844 (after October).
Presbytis priamus, Blyth, *Journ. As. Soc., Bengal*, xvi, p. 732, pl. liv, fig. 1, 1847.
Semnopithecus priamus, Anderson, Blanford and most recent authors.
Presbytis thersites, Blyth, *Journ. As. Soc., Bengal*, xvi, p. 1271, pl. liv, fig. 3, 1847.

Tolerably closely resembling typical *entellus* in size and general colour, the back and outside of the limbs varying from uniform sepia brown to slaty-grey, the crown of the head being brown and hardly contrasted with the tint of the shoulders, although frequently contrasted with the whiter hue of the cheeks and

brow ; but the hands and the feet are practically the same colour as the arms and the legs and not blackened as in *entellus*. Also the hair of the crown is typically raised into a compressed crest or tuft. The tail is like the back in colour except its extreme tip which is grey or buff and the whole of the under side, the inside of the limbs and the backs of the thighs are white or whitish.

Distribution. Southern India, the Coromandel Coast from Nellore southwards, to, according to Blanford, Trivandrum and up the Nilgiri Hills to a height of 6,000 feet, as reported by Davison. Also Northern and Central Ceylon as far south as Trincomali and the Kandyan Hills.

In regarding this langur as a distinct species from *entellus*, Blanford relied, so far as external characters are concerned, upon the pale hands and feet and the presence of the crest on the head. But the importance of these characters is lessened by the presence of pale hands and feet in *priamellus* and in the form named *anchises* by Blyth, the presence of a similar crest in *elissa* from S.E. Coorg, and its absence in the Ceylonese examples of *pallipes* named *thersites* by Blyth.

The following table shows the approximate dimensions in inches and the weights of some of the specimens obtained by the Mammal Survey :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
Cheddikulum, Ceylon, ♂	25″	36″	7½″	2″—	29½ lbs.
,, ,, ♂	23¾″	32″	7½″	2″—	25¼ lbs.
Mahendragiri Range, S. Travancore, ♂ ...	23″	26″	7½″	2″	...
Mankeni, Ceylon, ♀ ...	20″	34¾″	6″	1½″	15 lbs.
,, ,, ♀ ...	20″	30″	6½″	1½″	13 lbs.

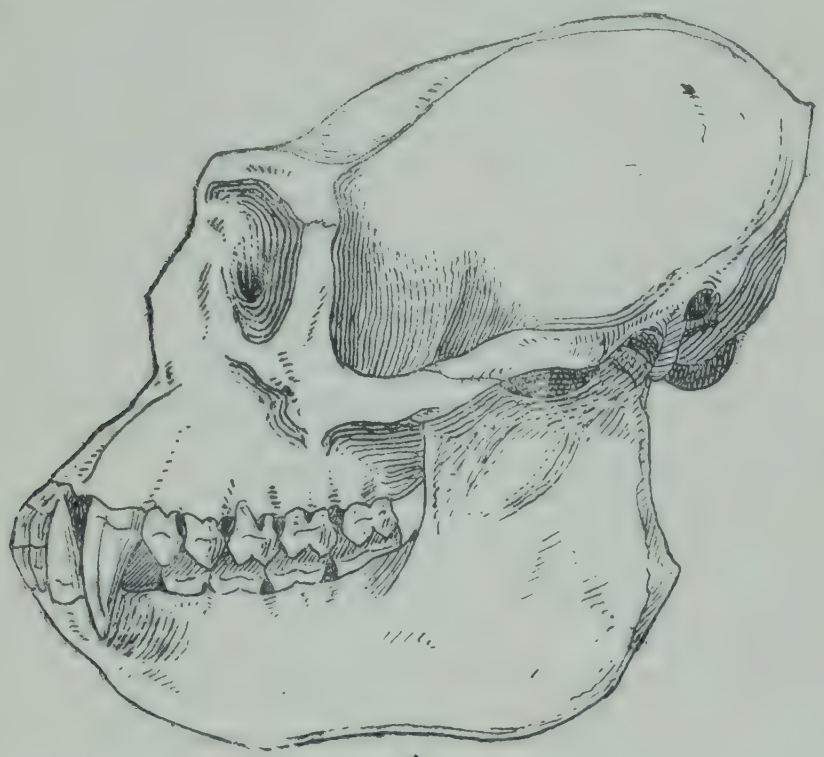
The Ceylonese examples were collected by Major E. W. Mayor in the northern and central provinces of the island, and the single example from S. Travancore by Mr. R. S. Pillay at Avambo at the foot of the Mahendragiri range.

These measurements show that the adult males are about the same size as *entellus* and *achates*, and suggest that the females are smaller ; but the two females measured are shown by their skulls to be scarcely full grown. Nevertheless, the skull of an adult female, recorded below, from the Nilgiri Hills, is considerably smaller than that of a male from the same locality, thus showing that in *pallipes* the sexual differences in size are as marked as in the skulls of typical *entellus*.

The measurements in millimetres of the available skulls are as follows :—

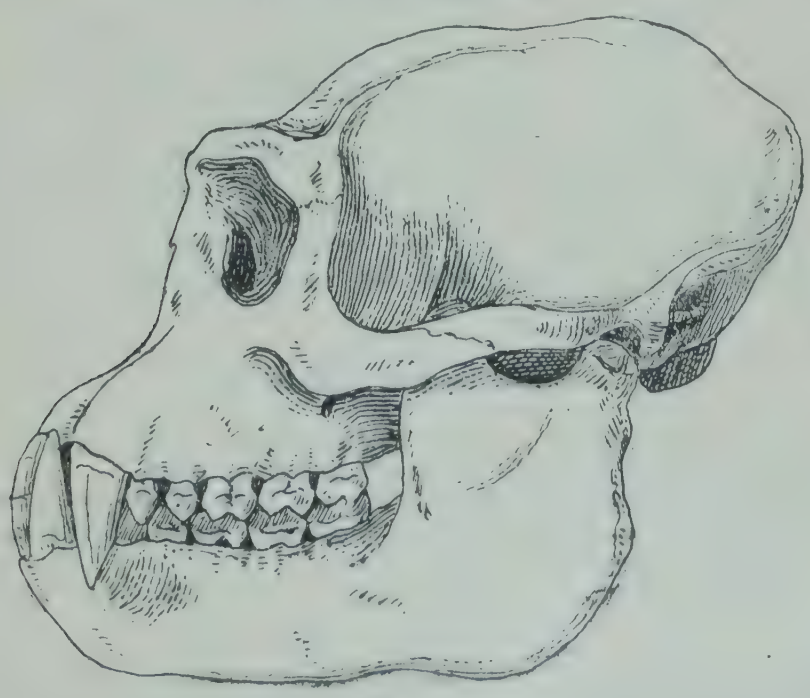
Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
Mahendragiri Range, ♂ ...	123	43	32	78	95
Nilgiri Hills, ♂ ...	122	45	34	78	97
Cheddikulum, ♂...	117	42	31	74	90
Nilgiri Hills, ♀ ...	100	36	30	65	82
Mankeni, ♀ ...	100	32	30	64	75
,, ♀ ...	100	33	30	63	78
,, ♀ ...	—	34	30	60	77

But the measurements convey no idea of the profound variation in the shape of the skulls. The skull of the adult male, collected by Davison in the Nilgiri Hills, which is certified by Thomas and Blanford to have been taken from the head-skin of a specimen of *pallipes* (*priam*), has the nose prominent, the back of the cranium high, the plane of the occiput steeply sloped and the lower jaw very massive, with the symphysis strongly inclined. But in the skull of the male from the Mahendragiri Range the nose is almost vertical, the back of the cranium is much less raised, the occipital plane is less steeply sloped, the lower jaw is less massive and its symphysis is more vertical. (Text figs. 10A and 10B.)



A

FIG. 10A.—*Pithecus entellus pallipes* from the Nilgiri Hills. ♂ ad. Two-thirds nat. size.



B

FIG. 10B.—*Pithecus entellus pallipes* from the Mahendragiri Range. ♂ ad. Two-thirds nat. size.

The female skull from the Nilgiri Hills (Davison) has the nose nearly vertical, the cranial portion short high and rounded and the lower jaw massive, whereas the female skulls from Mankeni in Ceylon have the facial portion less steep, the cranial portion lower and flatter, especially in one of the specimens and the lower jaw much less massive.

The skulls of adult males of *pallipes* differ from those of typical *entellus* in having the face lower and the upper jaw less massive; but they resemble in that respect, as stated above, the skull of an adult male of *entellus* from Deesa in Palanpur. This last-mentioned skull, indeed, is very like the skull of *pallipes* from the Mahendragiri Range except for the prominence of the nose, and in that respect it closely resembles the skull from the Nilgiri Hills.

The names *pallipes* and *priam* were given in the same year to this langur and Anderson, Forbes and Elliot, assuming apparently that *priam* was the first to be published, added *pallipes* to it as a synonym. But since *pallipes* was published in April and *priam* not until after October, it is clear that *pallipes* is the older name and by the law of priority must, if properly introduced, be adopted. Blanford omitted to quote it, possibly regarding the name as invalid. But Blyth applied *pallipes* to the 'reputed' Entellus monkey of Southern India which is quite different from the true *entellus*. Technically perhaps it may be claimed that this is not a description; but since Blyth had a skin and knew it came from Southern India, it is clear that by reputed he meant 'so-called' and not 'surmised.'; and what he said about this langur was quite sufficient to enable it to be identified with certainty. This apparently was the opinion of Anderson who quotes *pallipes* in the synonymy of *priamus* without any query as to the validity of the description or doubt as to the identity of the species. His verdict, being that of the first reviser, I have adopted.

The only other name to be considered is *thersites* given by Blyth to a langur from Nuera-Kalawa, west of Trincomalee in Ceylon, differing from *pallipes* (*priamus*) in having no crest on the crown. Blanford interrogatively added *thersites* to the synonymy of the Ceylonese langur *cephalopterus*, now known as *vetulus*; but Blyth was much too good a zoologist and knew the Indian langurs too well to have overlooked the very obvious differences between the *cephalopterus* and the *entellus* group of langurs; and it is quite clear from his figure and description of *thersites* that it belongs, as he said, to the latter category. It is most emphatically an *entellus*-like, not a *cephalopterus*-like monkey, and I have no doubt that it is identical with *pallipes* (*priam*), despite the absence of the crest. Kelaart also obtained a specimen in Ceylon without a crest.

Two langurs alleged to be representatives of these so-called species are figured side by side on Wolf's plate of Ceylon Monkeys in Tennent's *Natural History of Ceylon*, 1861. Wolf was a first-rate animal artist and his illustrations on this plate are so good that it may be inferred that they were drawn either from living specimens or skins. Now it is interesting to note that the top left-hand figure representing *thersites*, alleged to have no crest, has a crest as large as that in the Survey specimens, whereas the top right-hand figure, representing *priamus*, has a high peaked crest larger than in any example of this langur I have seen, although there is a good deal of individual variation in the size of the crest. I think it probable that the crest is actually or potentially present in all individuals of the race and that its occasional absence is due to moulting.

Pithecus senex, Erxleben.

Cercopithecus senex, Erxleben, *Syst. Regn. Anim.*, p. 24, 1777.
Cercopithecus vetulus, Erxleben, *tom. cit.* p. 25 (in part).
Cercopithecus kephalopterus, Zimmermann, 1780=*Presbytis*, *Semnopithecus*.
Pygathrix or *Pithecus cephalopterus*, Anderson, Blanford, Elliot, Wroughton and others (in part).
Pithecus vetulus, Hinton, *Ann. Mag. Nat. Hist.* (9), xi, p. 506, 1923 (in part).

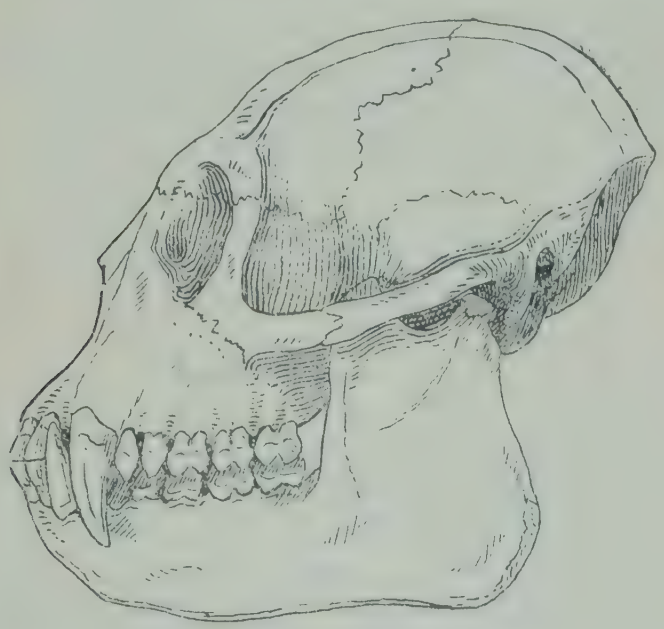
Resembling, except in albino specimens, the Langurs of the *Entellus*-group in the deep blackish-brown hue of the newly born young, but differing in the absence of the frontal whorl-like parting on the forehead, the presence of a patch of shorter paler hair upon the croup or loins, the black or brown tint of the under side and, usually at all events, in the presence in the female of a

white or whitish patch of varying extent on the pubic region below the callosities, and on the inner side of the thighs.

Distribution. Southern India and Ceylon.

The closeness of the affinity between the Langurs described below as subspecies of *Pithecus senex* was well-known to Blyth, Anderson and other authors. Hence the grouping of them under one specific name is not a novel idea, although most modern authors have followed Blanford in admitting three species.

The skulls, so far as my observations go, present a considerable amount of individual and but little subspecific variation. The sketch of the side view of the skull of *P. senex nestor* will give an idea of the general form. It will be noticed that the brows are not nearly so pronounced as in the subspecies of *Pithecus entellus*, so that the plane of the orbit is not vertical but inclined backwards. But the prominence of the brow and consequently the slope of the nose and the inclination of the orbit vary a good deal individually. (Text fig. 11A).



A

FIG. 11A.—Skull of *Pithecus senex nestor* from Panadura. ♂ ad. Two-thirds nat. size.

The skulls may be here dealt with comprehensively. There will be no occasion to do more than refer to them very briefly under the subspecific headings.

The following are the measurements in millimetres of a few :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width
johnii, ♂ (juv.), Cochin ...	108	32	30	65	80
johnii, ♀, Nilgiris.	108	36	31	64	83
johnii, ♀, Cochin.	95	30	30	...	...
vetulus, ♂, Anasigalla ...	103	34	26	61	74
nestor, ♂, Panadura ...	98	33	26	60	75
nestor, ♀, Panadura ...	94	32	26	60	72

These measurements suggest that the South Indian subspecies, *johnii*, has a considerably larger skull than the Ceylonese races *vetulus* and *nestor* ; but I

have seen a male skull belonging to a form from Ceylon closely allied to *vetulus* and *nestor* which gave the following measurements :—Total length 109, length of palate 39, of upper molars 28, orbital width 65, zygomatic width 80.

KEY TO THE SUBSPECIES OF *Pithecus senex*.

a	General colour white or whitish	*senex*.
a[1]	General colour brown or black.	
b	Crown and whiskers tolerably uniformly coloured buff or brown ; the throat darker than the crown ; general colour black ; the tail also mainly black	*johnii*.
b[1]	Crown and whiskers contrasted, crown brownish or buff, whiskers white or whitish ; throat lighter than crown ; tail greyish to brownish, not black.	
c	Coat thick and shaggy ; head and croup not sharply distinguished by colour from the back	*monticola*.
c[1]	Coat shorter and smoother ; head and croup more distinctly defined from colour of back in adult.	
d	General colour black, with head darker but croup patch silvery grey ...	*vetulus*.
d[1]	General colour brown, with head paler and croup patch grey to grey brown	*nestor*.

Subspecies *senex*, Erxleben.

Cercopithecus senex, Erxleben, *Syst. Regn. Anim. Mamm.* p. 24, 1777.
Semnopithecus senex. Schlegel, *Mus. Pays Bas, Simiæ*, p. 53, 1876 ; Blanford, *Faun. Brit. Ind. Mamm.*, p. 35, 1888.
Presbytis albinus, Kelaart, *Prodrom. Faun. Zeyl*, p. 7, 1852 ; *id, Journ. As. Soc., Bengal*, xx, p. 182, 1852.

Fur dense, wavy, of a nearly uniform white colour, with only a slight dash of grey on the head ; whiskers white, full and pointed laterally ; hands and feet with long white hairs overhanging the tips of the fingers and toes. Face and ears black, eyes brown ; palms and soles flesh-coloured.

Distribution. Ceylon, Matelle (Matale).

Erxleben gave the name *senex* to a white Ceylonese monkey referred to by Knox[1] as another sort of monkey, milk white both in body and face. This no doubt was a pure albino possibly, perhaps probably, belonging to one of the Ceylon races of Langurs recorded below ; and since *senex* has page priority over *vetulus*, the former name must, according to the rule, be adopted, although it was unfortunately probably applied to a variety. The available evidence does not at present enable us to say to which, if to any, of the now well-known races *senex* should be applied. In adopting the name I have, therefore, followed Schlegel who seems to have been the first reviser to affix *senex* to a definite type of Langur from Ceylon. This was represented by a specimen brought by Temminck from that island and presented to the Leyden Museum. Schlegel described it as yellowish-white, washed with brown on the back and with red on the upper side of the head and nape. Blanford, who saw what was no doubt the same specimen in Leyden, endorsed, with unimportant modifications, Schlegel's description of the colour, adding that the face and ears were black, the palms and soles flesh-coloured, the fur dense and wavy, the whiskers full and the toes well haired. He compared its dimensions to those of *P. ursinus* (=*monticola*) and the thickness of the coat bears out the view that the two are similar. Although the blackness of the face and ears and the wash of colour on the head and back show that this specimen is not so complete an albino as the white

[1] *Historical Relation of Ceylon*, vol. i, Ch. VI, p. 25, 1681.

langur recorded by Knox, Schlegel's application of the name *senex* need not on that account be set aside.

But many years before Schlegel's time, Kelaart gave the name *albinus* to a whitish Langur received as a living animal from Matelle, and his description applies so closely in a general way to Temminck's specimen, although the latter was paler, that there seems no reason to doubt that Temminck and Kelaart had very similar varieties of the same Langur. I have, therefore, followed Schlegel in adding *albinus* to the synonymy of *senex* and have reproduced Kelaart's description and fixed upon Matelle as the typical locality for *senex* in view of the possibility of the existence now, or in the part, of a very pale race akin to the darker races, *vetulus*, *nestor* and *monticola*. This possibility must be borne in mind because it is in a measure supported by an old record by Spence Hardy, quoted by Sir J. Emerson Tennent, to the effect that a troop of white monkeys was seen at Dambool on the rock upon which the great temple stands and by Blanford's statement that white monkeys might be seen occasionally on the Ceylonese mountains in parties of three or four, always apart from other monkeys.

On the other hand, Sir Emerson Tennent had a white langur, taken between Ambepasse and Kornegalle, where they were said to be numerous; and this specimen, according to him, had all the characters of *cephalopterous*, apart from its colour, which was strikingly white with the face and eyes black. He was told, moreover, that white monkeys had been seen near the Ridi-galle Wihara in Seven Korles and also at Tangalle. This suggests that the lowland form, probably *vetulus*, is addicted to albinism.

Subspecies *vetulus*, Erxleben.

Cercopithecus vetulus, Erxleben, *Syst. Regn. Anim. Mamm.* 3, p. 25, 1777. (= *cephalopterus* of later authors).

Pithecus vetulus vetulus, Hinton, *Ann. Mag. Nat. Hist.* (9), xi, p. 509. 1923.

Colour of back from nape to croup black finely speckled with grey; croup grey or silvery, this tint spreading on to outside of thighs and root of tail; tail greyish to greyish-brown; arms and legs at least from the knees downwards black like the back; head brown above; whiskers and throat mostly white but whiskers brown at the ends and some brown on the middle of the throat; under side and inside of limbs black, but some white on the pubic region beneath the callosities in the female.

Distribution. S. Ceylon from about Ranna through the Udugama Hills in the Galla District and up the western coast to the Kala Ganga River; probably also in Ratnapura.

This information regarding the range of this race was supplied by Mr. W. W. A. Phillips to Mr. Hinton, who quoted it in his paper.

The following table gives the approximate dimensions in inches of some examples of this race :—

Locality and Sex	Head and Body	Tail	Hind foot	Weight
Kalutara, ♂	24 —	28″—	6½″—	...
Anasigalla, ♂	21½″+	29″+	6½″—	12½ lbs.
Matugama, ♂	22″+	30½″+	7″—	...
Kalutara, ♀	23″+	27½″+	6″	..
Kalutara, ♀	22″	28″	6″—	11½ lbs
Anasigalla, ♀	21″	30″	6″	...

Subspecies *nestor*, Bennett.

Semnopithecus nestor, Bennett, *Proc. Zool. Soc.*, p. 67, 1833.
Semnopithecus kelaarti, Schlegel, *Monogr. des Singes*, p. 52, 1876.
Pithecus vetulus nestor, Hinton, *Ann. Mag. Nat. Hist.* (9), xi, p. 510, 1923.
Pithecus vetulus phillipsi, Hinton, *ibid.*

Differs from *P. senex vetulus*, in having the blackish hue of the upper and under sides and limbs replaced by deeper or lighter sepia brown which, toning more with the paler areas on the head and croup, lessens their conspicuousness. The whiskers, however, are white and conspicuous, the head is, ochraceous or buff, and the patch on the croup varies from silvery-grey to pale brown.

Distribution. Southern Ceylon ; the Panadura and Horana Districts, north of the Kala Ganga River, and ranging up the west coast to a little way north of Colombo and inland up the Kelani Valley, probably to the foot of the Adam's Peak Range.

This information regarding the range of this race was published by Mr. Hinton from information received from Mr. W. W. A. Phillips ; and Mr. Hinton has shown that it inhabits an area where the annual rainfall is less than in the area inhabited by *vetulus*.

The type of *nestor*, in the British Museum, is a half-grown langur, merely ticketed Ceylon. I cannot, however, distinguish it by any reliable characters from the series of skins, sent by Mr. Phillips, which were described by Mr. Hinton as *Pithecus vetulus phillipsi*.

The type of *phillipsi*, an adult male from Gonopola in the Panadura District, has the back, the arms and the legs sepia brown, with the limbs darkening towards the extremities and turning black on the hands and feet ; the croup patch and tail are grey, the head buffy brown and paler than the back, the whiskers and throat white and the lower side dark brown.

An adult female from Horana in the Panadura District is tolerably similar and has a white patch below the callosities.

Another adult female from Godigamiura in the Panadura District is darker brown both above and below than the type and has the croup patch, not grey and conspicuous, but pale brown as in the type of *nestor*.

The approximate measurements in inches of three specimens from the Panadura district are as follows :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear
Gonopola, ♂	20″	28½″	6½″	1⅓″
Gonabendaluwa, ♀ ...	22½″	31″	6″	1½″
Horanna, ♀	19½″	28″	6″	1⅓″

Subspecies *monticola*, Kelaart.

Presbytis cephalopterus var. *monticola*, Kelaart, *Journ. Roy. As. Soc.* (Ceylon Branch), ii, No. 5, p. 321, 1850, *id. Prodr. Fauna Zeylan*, p. 2, 1852.
Presbytis ursinus, Blyth, *Journ. As. Soc., Bengal*, xx, p. 155, 1851 ; and of Anderson, Blanford, Elliot, Wroughton and other authors quoted under *Semnopithecus*, *Pygathrix* or *Pithecus*.

A large mountain-form closely resembling *P. vetulus nestor* in colour but with shaggier longer coat, and the pale patch on the croup usually at all events less distinctly defined. Colour varying from deep blackish-brown to sepia brown on the back and limbs. Summit of head and nape always brown ; whiskers, throat and chin grey or white and contrasted with the colour of the head and chest. Face black, bordered with black hairs and with a line of black hairs between the eyes and expanding on the summit of the nose between the nostrils.

Distribution. Mountains of Southern Ceylon.

Examples of this fine langur are rare in collections. The British Museum has four examples only. An adult male from Adam's Peak (*S. B. Bell*) is dark blackish-brown, blackening on the hands and feet. The croup patch

is paler, sepia brown ; the whole of the crown of the head and the nape are also paler sepia brown and, like the croup-patch, are sharply set off by the darker hue of the back ; the whiskers, throat and chin are grey ; the tail, which in its basal half is like the croup patch, becomes greyer in its terminal portion.

Another adult male from Pattipola in the Central Provinces, where it was shot at an altitude of 6,200 feet by Major E. W. Mayor, is considerably paler brown than the one from Adam's Peak. Hence the croup patch and the crown of the head are much less conspicuous and the hands and feet are brown.

An adult female from Hakgalla Uva, 5,600 feet (*Major E. W. Mayor*) is also paler than the male from Adam's Peak but somewhat darker than the one from Pattipola. The patch of white hair below the callosities is quite distinct.

The fourth example, ticketed merely Ceylon and received from Dr. Kelaart, is too old and worn to call for comment.

Hitherto this langur has always been cited as *ursinus* ; but *monticola* appears to be the older of the two names. It was given by Kelaart to a langur from the higher part of the Kandyan Province, Nuwara Eliya, which was described as similar to typical *cephalopterus* (= *vetulus*) but without white on the inner side of the thighs and on the rump. It was also said to be larger and darker than its low country relative, with a rufous tinge on the neck and longer and more wavy hairs.

The following approximate measurements in inches are available from two examples collected by Major E. W. Mayor :—

Locality and Sex	Head and Body	Tail	Hind foot	Weight
Pattipola, 6,210 ft., ♂ ...	23⅘″	24¾″	7″	20 lbs.
Hakgalla Uva, ♀ ...	21½″+	26½″+	6½″	16½ lbs.

The type of *monticola*, a female from Nuwara Eliya, was probably young since, according to Kelaart, its head and body measured only 17 in., the tail being 26 in. and the hind foot 6 in. But he sent, he tells us, a larger specimen to Blyth, which was described by Blyth as *ursinus*, as Kelaart stated in 1852.

The largest specimen, so far as I am aware, of which the dimensions have been recorded, was measured by Elliot. The head and body were 28 in., the tail 31 in. and the hind foot 7 in. It also came from Nuwara Eliya ; but the measurements were taken from a dried and probably stretched skin.

Setting aside Elliot's specimen, it will be observed that, according to Major E. W. Mayor's recorded measurements, *monticola* is no larger than *P. s. vetulus* and *P. s. nestor*. It is true that made-up skins of *monticola* look larger, but this is no doubt largely due to the thickness of the coat. There is nevertheless considerable difference between *P. s. monticola* and *P. s. vetulus* in weight, *monticola* : being much heavier. Moreover according to the measurements recorded by Hinton in his paper quoted above, the skull of *monticola* (=*ursinus*) is about 10 mm., nearly half an inch longer than the skulls of *vetulus* and *nestor*.

Subspecies *johnii*, Fischer.

Simia johnii, Fischer, *Syn. Mamm.*, p. 25, 1829.
Semnopithecus, *Presbytis* or *Pithecus johnii* or *johni*, Anderson, Blanford, Elliot and most recent authors.

A mountain-race of large size, nearly as large as *monticola* but with the coat shorter, closer, blacker and more glossy on the body and limbs, the general colour being jet black, or nearly so, above and below. It differs also from *Pithecus senex monticola* in the uniform buff-brown tint of the long hairs of the crown and of the whiskers and throat, there being no contrast in tint between the whiskers and crown ; the tail also is nearly black and not very noticeably paler than the middle of the back, as in the Ceylonese forms.

Distribution. Mountains of Southern India, the Anamalai, Palni and Nilgiri Hills and the Western Ghats from Coorg to Cape Comorin.

The following table gives the approximate dimensions in inches of examples of this langur collected for the Mammal Survey by Mr. G. C. Shortridge and Mr. Riley O'Brien :—

Locality and Sex	Head and Body	Tail	Hind foot	W
Brahmagiri Hills, S. Coorg, 2,780-5,138 ft., ♂	26″	30½″	7″—	21½ lbs.
Kumblacodie, Cochin, 3,500 ft., ♂ ...	23″	34½″	7½″	...
Anamaad, S. Malabar, 3,200 ft., ♂ ...	22½″	37″	7¾″	...
Kukkal Shola, Palnis, 6,100 ft., ♀ ...	24″	32″	7″	25 lbs.

Made-up skins of this langur appear to belong to a considerably larger form than the typical Ceylonese *vetulus* and *nestor*. But the dimensions show that there is not very much difference. It is, however, a heavier animal as indicated by the weight. I have not seen the skull of a fully adult male, the one measured above 268 having the occipital suture open and the upper canines hardly longer than in the female. But the skull of the fully adult would certainly be larger than in the Ceylonese races *vetulus* and *nestor* and the teeth are larger.

Although this langur has always hitherto been regarded as a species distinct from the related Ceylonese langurs, it does not appear to me that its characteristics should be given more than subspecific importance.

(*To be continued*)


NORTH-WEST FRONTIER
GILGIT
GODWIN AUSTEN 28,000'
GOLDEN THRONE PK. 23,600'
KARA KORAM MTS
SKARDU
LE TIBET
SASSIR LA 19,400'
PANAMIK 14,000'
NUBRA R.
DEOSAI PLAINS 13,500'
BURZIL
LADAK RANGE
KARDUNG PASS 17,800'
SHYOK R.
WULAR L.
DRAS
ZOJI-LA 11,300'
SIND R.
SRINAGAR
KOLAHOI PK 17,900'
LEH 11,500'
GREAT HIMALAYA
LADAK
HEMIS 11,500
PHOBRANG 14,500'
MARSIMIK PASS 18,500'
CHANG-CHEN-MO
PANG KONG L.
TAKLUNG 17,000'
SHUSAL 14,500'
INDUS R.
PUGA 13,000'
PIR PANJAL MTS
PINDI
JHELUM R.
INDUS R.

A COLLECTING TRIP TO LADAK

BY

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PART I

(*With a map and five plates*)

It was a happy opportunity that allowed me to hitch my cart behind that of Col. Meinertzhagen's, when he organized a collecting trip to Ladak and on to the borders of Chinese Tibet for the purpose of acquiring a thorough knowledge of the resident bird life at the higher altitudes, and also authentic proof of the migratory species that cross the Great Himalayas and breed in the highlands of Ladak and Little Tibet. The success of this collecting enterprise and the subsequent recognition of new species added to the fauna of Ladak was the work of a congenial employer and friend and a first-class organizer. It is to him I owe whatever knowledge I have of systematic collecting and of preparing bird skins that will be a 'thing of joy for ever.'

The path of a bird collector is not always strewn with roses. His peregrinations may take him, at times, well beyond the pale, where perhaps, through sheer malice, he may see a 'snow man' and come back to us with photographic proofs of human foot-prints in the snow.

On the other hand the field is infinitely varied. There are hunting grounds to suit all tastes. The arid desert, the tropical forest with its varied and multi-hued denizens, or the bleak glacier-hung mountain top.

Col. Meinertzhagen and I left Pindi on February 21 and passing up the picturesque Jhelum Valley arrived in Srinagar on February 27, having collected a good many migrants on the way.

We left Srinagar on March 23 and crossing over the Great Himalayas at the depression known as the Zogi-la Pass, followed the Indus Valley and reached Leh on the 6th May. Leaving Leh on the 17th May we crossed over the Ladak range by the Changla and Marsimik la passes and reached Changchen-Mo Valley on the 31st May.

Retracing our steps we made a wide detour, skirting the Pangkong Lake to Shushal and thence crossing the Indus reached Puga on June 20. Returning to Leh we struck north and arrived at the foot of the Kara Koram Range on July 22.

We returned again to Leh and worked down the Indus to Skardu in Baltistan on August 13. Thence we returned to Kashmir by way of the Deosai Plateau and reached Srinagar on September 5.

During the period of collecting we covered over 2,000 miles and in the course of our travel reached an altitude of 21,050 ft. in the Kara Koram.

The Vale of Kashmir is described as a saucer-shaped valley between the Great Himalayas and the Outer Himalayas or the Pir Panjal

Mountains between the Great with a length of about 80 miles, a breadth of 24 miles, and a mean altitude of 5,600 feet above sea-level, corresponding in latitude to Palestine, the Mediterranean and California. Thus it has a blend of temperatures which should compare favourably with any other summer resort in the world.

For its genial beauty Kashmir should stand alone, for here you have a combination of lakes, the quiet beauty of cultivated fields and gardens, and a snow-capped mountain range which completely encircles the luxuriant valley.

It would be as great a mistake to generalize on the character of the Kashmiri, as to accept the theory that all Kashmiri women are beautiful. Yet if we must err, let it be on the side of caution. Sir Francis Younghusband, for many years Resident of Kashmir, has written a very interesting book on this province, and, as a man who knows what he is talking about says, 'A Kashmiri soldier is almost a contradiction in terms. There is no such thing. They will endure and suffer but they will not fight. And they are very careful of the truth.' Col. Meinertzhagen added a rider to that by saying, 'They are so careful of the truth that they seldom use it.' However, it is to their splendid endurance there we owe the success of our enterprise.

We had arrived in that 'Valley of Bliss' just when the almond blossoms were in bloom and Kashmir was warming up after a rather severe winter. We had intended staying in an hotel, but this became impossible. Being the earliest visitors we were preyed upon by every shopkeeper who had anything to sell. The climax of Col. Meinertzhagen's patience seems to have been reached when a none too clean fellow offered to give him a Turkish bath!

The 'Season' had not begun when we arrived in Kashmir and the houseboats were piled up along the banks. The Kashmiri boatman claims Noah as his ancestor and if, as Younghusband says, 'they didn't borrow the pattern of their boats from Noah, he must certainly have borrowed it from them.' They are known as MANJIS and live entirely on their boats with their families and cattle, and one can picture the squalor when all agree that the Kashmiri could make Kashmir prefection if only he would wash. We engaged a houseboat which gloried in the name of 'Arabella' but nothing else happened; and slipping anchor from a regular hulabaloo of 'Papier Mache Sir.' 'Shampoo—furst Class?' and one or two pointed remarks as 'Hair cut and Shave Sir?' we worried our way down stream through the crowded waterways to the accompaniment of frantic yells of our boatmen and a return 'cuss fire from Kashmiri bargees' wives, which if understood suits the circumstances down to the ground.

We glided down the river passing the Maharaja's Palace and just beyond the precincts of the city a fair amount of dead horses and cattle, which the Kashmiri delights in pushing into the river when their days are done.

The most conspicuous object in the immediate neighbourhood of Srinagar is Takht-i-Suleiman, 'The throne of Solomon' a bare rocky hill rising 1,000 feet from the floor of the valley, and sur-



HOUSE-BOAT *Arabella* ON WULAR LAKE.



SIND VALLEY, ONE OF KASHMIR'S PICTURESQUE SIDE VALLEYS.



BALTAL, 9,000 FT., AT THE HEAD OF THE SIND VALLEY.



KOLAHOI, 17,800 FT., A CONSPICUOUS PEAK IN THE GREAT HIMALAYAS, WITH ITS GLACIER REACHING TO THE TREE-LINE.

mounted with a Hindoo temple. The view from this height will repay the climb. On one hand the climber looks down on the town of Srinagar, the Venice of the East, with its numerous waterways and gaily coloured boats, following the course of the Jhelum with little hamlets and temples clustered on its banks, and then away over the valley the land rises to the pine-covered slopes and the culminating touch to every Kashmir scene—the snows. Looking in the opposite direction the view is not so extensive. In the foreground the Dal Lake with stately poplars on its shores and on its placid waters the famous Isles of Chenars, mirrored again in its crystal clear depths. Fleecy clouds crept over the snow peaks that strung out in a jagged line against an azure sky while a bluey haze hung over the valley and the sparkling domes of the temples sent back the rays of the setting sun.

We camped in the lee of a craggy hill and had an uninterrupted view across the still waters of the Wular Lake to the stupendous snow-clad mountains, that stretched across the eastern sky. The pass into Ladak and the land of the laughing Bhudda led over these mountains, but was considered impassable at this time of the year. We decided to wait a month, and fill in the time collecting birds in the vicinity.

Few of the summer visitors, in the course of their migration from the plains and foot hills had arrived, though in those quite historic gardens of Shalimar where the 'playing fountains'—never play, the Paradise Flycatcher, or as he is known to the residents of Kashmir the 'Ribbon-bird', with a flash of satin white, darted among the dark green of the chenar trees.

At dawn the call of that game little fellow, the Chukar, who can be relied upon to give a good morning's sport, is echoed back and forth among the hills. Higher up on the pine-covered tops are the haunts of the Koklass (*Pucrasia macrolopha biddulphi*), and the Nutcracker (*Nucifraga multipunctata*).

In the valley the House Crow is entirely replaced by the Jackdaw during winter, and the sight of these birds leaving the valley in thousands every morning for villages along the Jhelum Valley and returning to roost among the chenar trees in the heart of the town, can hardly be missed by any visitor.

With the rise in the temperature and the melting of the snows on the heights, we decided to commence the trek that was to take us into Ladak and allow us to dangle our feet into Chinese Tibet. On the 25th March we bade farewell to the 'Arabella' at the mouth of the Sind River and moved up that beauteous valley, which at any season surpasses in beauty any other side valley of Kashmir. A thick forest of fir covered the northern slopes with glimpses of snow showing through the dark green, and toy-like villages clinging to the lower slopes.

Such natural beauty of scenery, the varied bird life and exhilerating climate enhanced our collecting spirit considerably. Even our local shikari, who usually suffered from a stomach or a backache, 'girded up his loins' to bag the wary Monal Pheasant, though these when brought in were too full of holes and lead to be of much use for specimens or the pot.

Small parties of Tits, Tree-Creepers and Nuthatches, which consisted of *Parus major kaschmiriensis*, *Parus melanolophus*, *Parus rufonuchalis rufonuchalis*, *Sitta europæa kashmiriensis*, and *Certhia himalayana* (?) frequented the forests. The sub-specific rank of this last bird is under discussion as being intermediate between the Himalayan and Turkestan races.

The Orange Bullfinches (*Pyrrhula aurantiaca*) were not uncommon in the fir forests. Col. Meinertzhagen writes of this bird in the *Ibis* of July 1927, 'The brilliant orange of their plumage showed up like some precious stone on the drab dull green of the ground on which they fed. After a moment they would fly up into a tree, soon to return one by one and sit quite still munching small seeds. Their dislike of movement when feeding and when in a tree was due to their inherited consciousness that in such brilliant plumage they would become visible and an easy prey to any feathered enemy.'

As we moved higher up the valley, forest bird life became scarcer.

The few that braved the winter conditions at 8,000 feet were the Brown Dipper, White-capped Redstart, Guldenstadt's Afghan Redstart, and higher still, the White-breasted Dipper.

On the 7th April we left Traghol, 9,500 feet. This was our fourth day in this picturesque valley. Each day brought forth more wonders in mountain scenery ; each turn in the road a surprise. The thick belt of fir trees thinned out ; giving place to the slender hardy birch. Snow lay thick everywhere, at times completely bridging the river, and then one enters Sonamarg. Glaciers move down the flanking mountains, and in spring, the snow having melted, the glacial formation reaching down to the tree line, is a mass of dazzling ice and bare jagged rocks.

Kolahoi, 17,850 feet, its sharp peak conspicuous from any point along the Sind Valley ridge is the highest point in the Great Himalayas. The peak is six thousand feet above the glacial formation, which stretches down to the tree line.

We arrived at Boltal 9,700 feet on the 10th April. It has a delightful dak-bungalow at the head of the Sind Valley, and is completely surrounded by the wildest and grandest scenery of snow, mountain and mist.

This is the stage when the traveller realizes what he is up against. The Zogi-la Pass which crosses the Great Himalayas into Ladak and which is usually open to traffic after the 15th May, was bunged high with snow ; the only alternative was a snow-bound, precipitous ravine that really was a frozen mountain torrent, covered over with snow.

We remained three days here and every day were made acquainted with the awe-inspiring sight of avalanches. With the thawing of the snow, a few tons would rush down the slopes with the roar of an express train.

The traveller can never be too cautious in his plans of an assault on these mountain fastnesses during winter.

He must be up and away before dawn to avoid the avalanches, his face and hands well greased to avoid frost-bite, his feet shod

with grass shoes for a firm foot-hold on the frozen surface of the snow, and, as fancy dictates, a flask of rum or brandy, or if this is 'haram,' chocolate will be found an admirable substitute.

At an ungodly hour in the early dawn of Easter Sunday on April 13 when the temperature was below zero—and our circulation almost that—we set out for the assault on the snow-bound ravine. Ten minutes brisk walk brought us to the foot of the ravine.

Here each man readjusted his load and snapped his belt into the 'starvation hole.'

The coolies were dimly visible in the darkness which precedes dawn as they grouped together for a final smoke. Their gnome-like figures stood out against a sombre sky, and little points of light from their cigarettes, stabbed into the darkness. Col. Meinertzhagen gave the signal and we fell into single file and began the assault.

That scramble up the ravine lasted a little over an hour and for the greater part it was a 'fly-on-the-wall' business. To add to the discomfiture, a howling gale, accompanied by a blizzard, tore down the closed-in ravine. 'A gale,' as our cook said, 'guaranteed to disembowel a camel,' or the equivalent to that in Hindustani.

Looking back on the events of that day, my diary helps with the one elucidating word—'Hell,' followed by notes of exclamations, queries and asterisks, which apparently had its soothing effects, and continues 'But still the wind blew, howling over the peaks, the stinging snow finding its way down your neck, in your ears and nostrils. The fine snow being blown from the heights, resembled, as it caught the sun's rays, a spreading white fire.' We topped the pass and paused for a 'breather' and watched the coolies; these gallant fellows who will not fight, but who can be thoroughly relied upon in these mountains, were putting up a final spurt to gain the top, and as they filed past with their 40 lbs. loads, we could not help but cheer.

Physical disasters have made the Kashmiri selfish; tyranny has made him a liar, and superstition has made him timid. Yet, as he swings along, to the lilt of a mountain song, indifferent to the cold or steep ascents, we have nothing but admiration to offer.

We were now in that range of snows, the snowy range *par excellence*, which extends in a southern direction in a line of snowy peaks, seen from Simla, to the famous peaks of Gangotri and Nanda Devi in Garhwal. And we struggled along over a snow-bound freezing cold valley, among the snow clad giants for three days, seeing extremely little of bird life. The winter conditions prevailing in the region, would hardly appeal to any birds, not even to that curious bird which seems to spend its life either flying at ridiculous altitudes or sitting on bare rocks—the Chough.

As we neared Ladak the temperature rose, though the altitude (11,500) remained the same, and on the 16th April we were thankful to see the last of the 'snowy range *par excellence*,' and which, omitting those unrivalled mountains seen from Darjeeling, is second to none.

We fully expected to see, after crossing the Himalayas, a broad undulating plateau stretching away from our feet to the eastern

horizon ; instead our vision was plunged into a conglomeration of barren hills, parched valleys and gaunt Bhuddists' monasteries, which seem perched on every peak.

The track now followed the contour of the hills, with not a tree to break the monotony of barren hillside or a river cradled in the valleys. At Molbek the atmosphere, people, and villages entirely change. We were walking now on 'the roof of the world,' among an ancient race, with still more ancient customs. Monuments, prayers and supplications carved and inscribed on stone, are piled high along the caravan route which reaches to Leh, the capital of Ladak.

We put in a few days at Molbek chiefly for the Himalayan Snow Cock (*Tetraogallus himalayanus*) which were quite common on the hills, and secured quite a good series with the help of Tibetan guides who take their pleasures in dead earnest, and appear to delight in seeing you, purple about the gills, climbing to 14,000 or 16,000 feet in pursuit of these birds.

We found that these descended to the river at an early hour of the morning for a drink, and, as the day warmed, moved higher up—at times to the summit of the bare hills—where they roosted during the warmer hours of the day, at elevations of 14,000 and 16,000 feet. They rarely fly, and then only to cross the valley, if hard pressed by a sportsman. They weigh about 5 lbs. and it takes a good knock to bring them down. During the breeding season they utter a long drawn-out whistle—a dismal sound well associated with the dreary isolated haunts of this bird. The limits of the Himalayan species appear to be at 16,000 feet, and roughly all that region south of the main Ladak chain. Further north, the Tibetan Snow Cock replaces the Himalayan.

To refer again to the Tibetan gun-bearer : he has no equal in these hills, possessing, as he does, an unflagging spirit, an unquenchable zeal and a clean sense of humour—but keep to windward of him, for if to his lee you can judge the full extent of his cleanliness! !

The road now follows the course of the Indus and we plunge again into a labyrinth of confined valleys and gorges, shut in on either hand by vertical walls of rock, and emerge with the Indus into a flat bottomed broad valley that gently slopes to the foot of the Ladak range, where the flat roofed houses of Leh crowd around the monastery, as chickens do round a well-fed hen.

Leh, the great emporium of the trade which passes between India, Turkestan and Chinese Tibet, has been the starting point of many an adventurous journey into the last named country. The town does not seem to have much of a historical past. The unwarlike Ladakis, even with nature fighting on their side, were conquered by the rulers of Kashmir. The Kashmiri troops left to garrison Leh were, on one occasion, slaughtered by a strong force of Chinese from Tibet, since when Ladak, though still a province of Kashmir, is ecclesiastically subject to Lhassa, paying tribute, in the guise of presents, to mollify the Chinese who are held in wholesome fear by the Ladakhis to this day.

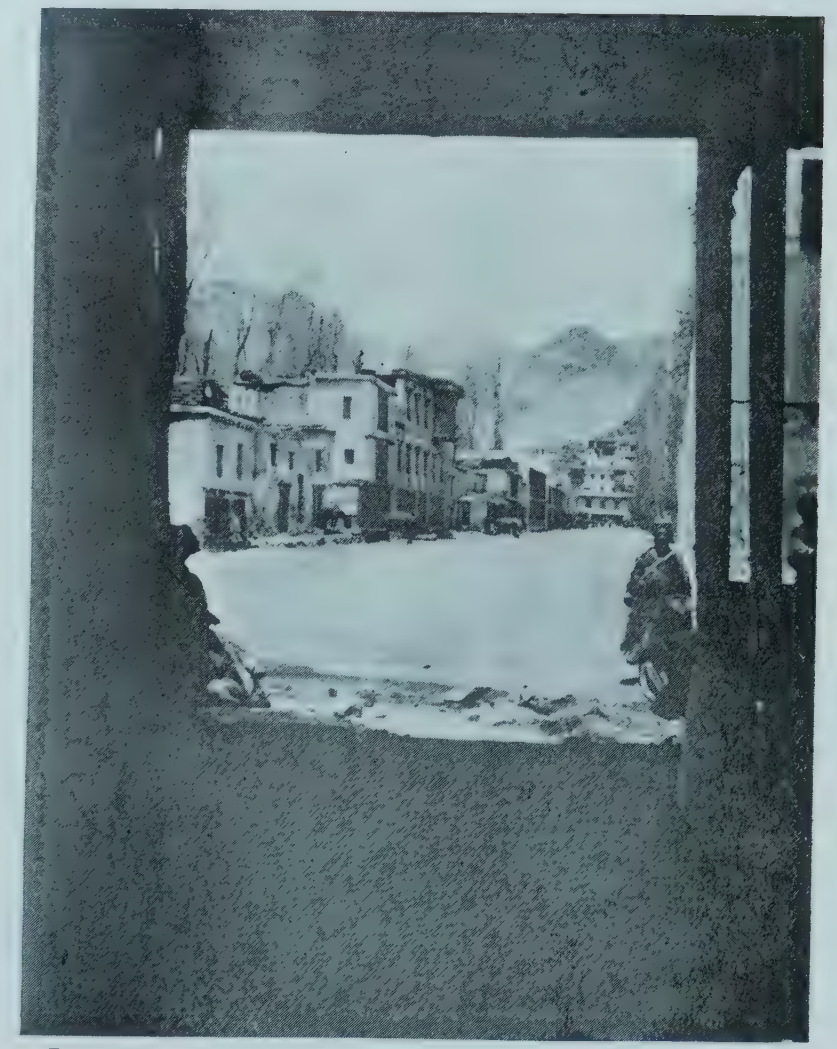
The Ladakhi, or 'hybrid' Tibetan is of a mild easy-going disposition, thoroughly honest, with the thinking capacity of a Yak.



A Morning's Bag of Snow Cock at Moulbeck, 11,000 feet.



Market Place at Leh, and the 'Gompa' above, the Winter Quarters of the Ecclesiastical Head of Western Tibet.



LOOKING THROUGH THE GATEWAY OF LEH TO THE LADAK RANGE.



LEH IN SPRINGTIME.

The effects of high altitude may account for his wholesome horror for any form of manual labour and he seems fortunate in possessing a spouse who fills the roles of husbandman and handmaid. A part of her dowry is a turquoise studded headgear—the remainder of it—her slave-like willingness to work.

The price of a bride or brides, fluctuates with the supply, and on our visit in 1925, the women constituted 80 per cent of the population of Leh. What a happy hunting ground is Leh for our bank-nighted bachelors of Bombay!

Since time immemorial, man's soul has yearned for a ball of some kind. An 'oblong' one, a wooden one, or even a rag one. But a ball of some description it must be and until he gets it, he is never really happy. The Ladakhi is no exception to the rule. Every fair sized village has its polo ground and though the game, as played in the plains of India, is a tame affair to the one played here, there is a general tendency to adhere to rules.

Throughout the hour's play there is no change of ponies, the game is fast and furious, and the ball never out of play.

Fouls are unknown; in a scrimmage, you may take a 'whack' at your opponent or his horse. On occasions the game is played down the broad main street, and no rule exists preventing an attack from a player who has lain in ambush in one of the shops flanking the polo ground.

The word '*pulu*', which means 'ball' in Tibetan has given rise to the theory that polo originated among the Mongolians, but history tells us that the game drifted from Persia through Turkestan into China and Japan, thence from Tibet to Gilgit and so to the plains.

The earliest records of this 'game of kings' in Tibet seem to tend more to feats of horsemanship and skill with stick and ball, than to the scoring of goals.

The nature of the present game is a mixture of the two. The ball is brought into play, in the event of a goal, in a most skilful manner. A player gallops at full speed down the 'wing' and, near the half way line, still at full gallop, tosses the ball into the air and smites it square towards his opponent's goal.

Being the centre of the trade of these parts, Leh boasts a reasonable sized bazaar and market.

Goods are more often bartered for goods than sold for cash. The Yarkandi from over the Kara Koram arrives in Spring with his caravan of wool and dried fruits, exchanging these for silks and wearing apparel from Kashmir. The Tibetan after a long and arduous journey over wind-swept desolate plains, arrives with his loads of Chinese brocade and quaint ornaments. The Kashmiri floods the market with all conceivable goods, even to the extent of European provisions. The Ladakhi contributes an occasional Yak tail.

Above the market and perched on an impassable rock are the winter quarters of the ecclesiastic head of Western Tibet. Like most monasteries it has an equally impassable 'stairway' leading up to the entrance, but offers no other obstruction to sightseers.

Bhuddhism may not interest everyone of us, and few travellers have the time to 'worry' about such matters. We accept the

existence of those silent edifices as part of the abominable landscape and pass on. Yet in those silent evenings, when the clouds have crept up the valley, the monastery sticks out above like an isolated island in a billowy sea; when the still night air throbs with the sonorous convocations from the deep-throated trumpets up in the monastery, when the moon shines down on the unscrutable face of Bhudda—it would almost seem as if Bhudda walks this earth again.

We have not the desire to tackle Bhuddhism, nor the time to dip into dimmest antiquity. With our object ever in view we begin preparations to leave Leh for the borders of Tibet proper, the region of the wild yak, the wild ass and the fabulous unicorn of Tibet.

No jungle exists in the whole of Ladak; the few trees, mostly willow and poplar, are planted in villages for building purposes and fuel. The traveller will find no 'shady' tree under which to have his lunch between stages and, as he travels higher the gardens around villages will thin out and disappear.

The bird life then, for the most part, is terrestrial in habits and palaearctic in its zone of distribution. Thus the traveller meets, when he crosses the great Himalayas, the Magpie (*Pica pica bactriana*). Col. Meinertzhagen points out, in his paper on the Birds of Ladak in the *Ibis*, that the Magpie is essentially a bird of the wind-swept, open and almost treeless Ladak, in contradicton to Baker's habitat of this bird as being Kashmir, Kumaon and Gharwal.

Visitors to Kumaon and Gharwal will bear out the statement of Col. Meinertzhagen that the Magpie is not a bird of 'well-wooded' parts. Observations in Mesopotamia, Persia and Baluchistan, all countries that could do with a bit of vegetation, shew that the Magpie frequents the upland steppes.

The Tibetan Raven (*Corvus corax tibetanus*) is met with all over Ladak. His bell-like tones should be unmistakable to any visitor to the highlands of Ladak.

The Red-billed Chough (*Pyrrhocorax pyrrhocorax himalayanus*) extends over the greater part of Ladak, chiefly over 12,000 feet. It occurs on either side of the Great Himalayas as low as 6,000 feet in winter, up to 19,000 feet in summer.

The Yellow-billed Chough (*Pyrrhocorax graculus forsythi*) hardly distinguishable, on the wing, from the above bird appears to frequent the same localities—though not quite so common. Both these birds were breeding at Leh at 11,600 feet. Horned Larks (*Eremophila alpestris longirostris*) were common from 12,000 feet to the snow line.

The Great Tit (*Parus major kaschmiriensis*), common on either side of the Himalayas, extends for a considerable distance into Ladak, wherever there were trees.

Snow-Cocks (*Tetraogallus himalayensis himalayensis*) and the Chukor (*Alectoris graeca pallescens*) as distinguishable from *Alectoris graeca chukar*, a darker race, were common in the alpine regions of Ladak.

We left Leh on the 17th May for the valley of Chang-chen-Mo, 245 miles westward, which is the furthest point reached by any

traveller, for beyond lies a wilderness of the coldest, bleakest and most desolate region conceivable.

We crossed over the Ladak range by the Chang-la pass, a regular corker in the way of passes—and one which touched the scale at 18,000 feet.

We had camped just below the pass at 15,700 feet the evening before the ascent and were fortunate in securing a fine series of Brandt's Mountain Finch (*Montifringilla brandti hæmatopyga*). They appear to be birds of the extreme altitudes and are met with usually on the fringe of the snows, upto 18,000 feet.

Before we crawl over the pass, I must dip my flag to Col. Meinertzhagen, who, with the tenacity with which leaders are made, got us over the pass when things looked their worst.

A relay of coolies were engaged to prevent any unnecessary delay on the pass, for what with the height and the thawing of the snow progress must be slow. There is an added danger after sunset on such passes. A caravan caught after sundown at 18,000 feet, would find it difficult to get through without losing a large part of its 'cattle' and men. Such a catastrophe cannot be prevented in view of the sudden drop in the temperature after sunset.

When tackling a high pass, you must, like Felix, 'keep on walking'. It is preferable, to becoming a ruddy icicle, and helps the circulation. Your progress may resemble the gait of a beetle over the ridges and furrows of a ploughed field, but there is always the consoling thought that all passes have a summit.

As much as I would like to forget this one instance of the effects of high altitude, it may not come amiss to give first hand experience.

At altitudes over 16,000 feet, or at times 15,000 feet, it depends on one's physical condition, the traveller begins to feel the oppressiveness of the atmosphere. The mere act of turning over in bed is a respiratory exertion; while ordinarily the respiration resembles the effects of a second hand bicycle pump.

A general listlessness is first observed, followed by a splitting headache, as if a smack has been taken at the skull with an axe—and the iron left in. Follows, if you have got it bad, a violent desire to be 'sick.'

I doubt if there is any preventive for these effects, though 'Crystallized Ginger' may be recommended.

There is also a tendency to knock off 'food stuffs,'—particularly meat, though the craving for 'sweet stuffs', such as sugar and jam, increases.

If on the other hand you are one of those who are blessed with the innards of a Tibetan—the symptoms will be noticeable in your camp. Your cook, if you haven't left him to die on one of the passes, usually finds he has a shocking grievance against the Shikari or *vice versa*. This being appeased, he develops a complication of disorders and a desire to peg out.

We crossed over the Changla pass and eleven miles beyond camped in a willow garden at 14,500 feet. Just beyond the pass we secured a Goosander (*Merganser castor*) which occurs sparingly on large sized rivers above 10,000 feet. Later on (July) we found the young in down on the Indus River below Leh.

The Brahminy Duck (*Casarca furruginea*) was first met at about 16,000 feet though they became commoner as we approached the more isolated watered valleys.

We now entered the higher uplands or the ' Changlung '—a name given to all that region north of the Ladak Range, and the floors of whose valleys rose from 14,500 feet to over 16,000 feet in the Chang-chen-mo. The mountainous chain that cuts across from northwest to southeast is a continuation of the mighty Kara Koram Range, which can be a real nuisance in its quiet way.

The pass over this range, the Marsimik-la Pass, topped the scale at 18,500 feet, and the ascent from 15,000 to the summit, in less than two miles, is a steady pull.

We had left Phobrung, which is the most easterly limit of ' civilization, ' in its broadest sense, on the 28th May and getting over the pass in fine style camped at 17,700 feet on the site of a Tartar camp.

Our transport consisted entirely of yaks, or to be more correct the hybrid known as ' zhoe. '

Wild yaks occur on the Chinese-Tibetan border at extremely high altitudes. Pocock mentions them as occurring in the Chang-chen-mo valley at 20,000 feet in summer, descending to less snow covered country at 15,000 in winter. According to local intelligence the wild yak breeds between 20,000 and 22,000 feet, and the young are captured soon after birth.

The method of capture, and we give it for what it is worth, is for a party to rush down on the parent yak, with tom-toms and cat-calls thus driving it off. It is hard to believe anybody ' rushing ' about at these altitudes, burdened with tom-toms to say nothing of great demands on the respiratory organs without cat-calls! The Tibetan is a wonderful fellow, and if, as some affirm, his pig-tail is used as an appendage by which Bhudda hauls up the ' failful '—to Nirvana, we should think that even without it, his sheer toughness ought to get him there.

At our camp at 17,700 feet it had snowed heavily all night and we had become anxious for our yakmen. But any anxiety was unnecessary. These hardy mountaineers had bunched together and allowed the snow to pile up over them and though not quite so comfortable and hygienic were decidedly warmer than we in our flapping tents!

The ' Zhoe ' will be found the best mode of transport over heavy snow and high passes. The novice will find he has not many lengthy intervals of rest once the animals get a move on. The older beasts appear to be ever thinking of a point ahead which they would rather have behind them.

On the 30th May we entered Chang-chen-mo valley. If there be any colder bleaker spot in this world, let me not know it.

When I look at my diary written at these altitudes, the general tone shares the pessimism of our cook. North, East or West was an unbroken panorama of bleakness and desolation, devoid of vegetation or any sign of human habitation.

Then, as if not satisfied with her effects, Nature let loose a piercing wind down the narrow valley, which very nearly froze the marrow in one's bones.



Our Transport of Hybrid Yaks.



Camp at Chang-chen-mo Valley, 14,500 ft.
Breeding Ground of Brahminy Duck.

However we seemed amply repaid for these discomfitures, from a natural history point of view of course.

The Tibetan Snow-Cock (*Tetraogallus tibetanus tibetanus,*) replaced the Himalayan species but were harder to obtain owing to the high altitudes (17,000 to 20,000 feet) which this bird frequents. In habits they do not differ from the other bird and appear not quite so shy.

The semblance of the track we had followed now disappeared entirely.

We observed a herd of Wild Asses that stood and took stock of our party, while we stumbled over the boulders. It may not do your temper much good to have a Wild Ass with his ears cocked, looking down on you as you worry your way along, but you soon get used to him and the ridiculous capers he cuts around the lagging transport.

The sight of a man seems to excite his curiosity immensely, and he will at times approach to within 25 yards for a thorough inspection of the biped.

I was able to observe a fine specimen at close quarters. After semaphoring with his ears he decided to take a walk round and then for no apparent reason, spun around and fled as if the furies were behind him. One could understand this behaviour if he had had a Tibetan to windward.

At the time I had put it down to my Kashmiri-cured posteen—but sportsmen have commented on this behaviour and its disturbing effects on other game—particularly *Ovis ammon* and the Tibetan Antelope.

The Tibetan Antelope, we find from ' Al Khanzir's ' narrative in one of Blackwood's numbers to be the ' original ' unicorn of Tibet. The horns of this animal are so placed that in profile they resemble a single horn.

The Tibetans most naturally do not admit this and ' Al Khanzir ' gives us the legend ' that should a unicorn espy a virgin he will instantly lay his head in her lap and look up into her eyes like a love sick swain '.

Such an incident has never occurred and though maidens are not plentiful in Tibet, they certainly do exist !

We shifted camp the next day, and ' discovered ' a delightful spot on the lee of a high cliff. A clear stream flowed past our camp, while all around were bushes and a grassy lawn.

The Brahminy Duck had its young here, all in down. The eggs are laid in a hole on the hillside and the young as soon as hatched are carried down to the water by the parent birds. A brood consists of six to eight eggs.

A common bird and one which turned out to be a new race, was the Ladak Twite. Col. Meinertzhagen has named this *Acanthis flavirostris ladacensis* and gives the following description :—

' Ladak birds are thick-billed as in *rufostrigata*, but differ from that race in fresh plumage in having the upper plumage not so red. In worn plumage Ladak birds are scarcely distinguishable from *rufostrigata*. They differ from *montanella* in having a richer and redder tone on the upper parts.

' A series of ten birds were obtained at Chimre (11,900 feet, May), Tankse (12,900 feet, May), Chanchenmo (14,800 feet, June), Pangkong Lake (13,900 feet, June), and Moulbekh (10,350 feet, August). Wings of five males 80-81 mm. and of five females 73-81 mm.

' The Ladak Twite is common wherever met. It is apparently confined to Eastern Ladak (my Moulbekh specimen being a solitary bird and probably a straggler from elsewhere). Observed at Zingral, Tankse, Pamzal, Pangkong Lake, Shushal, Puga, Tso Kar, Debring, and at Khardung. In summer they seldom come below 12,000 feet or over 15,000 feet.

' Nests with eggs were found at Tankse on May 21, on the Pangkong Lake on June 8, and on the Tso Kar on June 23, Clutches numbered three eggs in three cases and four eggs in three cases. Nests in low bushes (once 7 feet from the ground in a willow-tree), with thick lining of yak-hair.'

We left Chang-chen-mo Valley on June 4 and retracing our steps topped the Marsimik-la pass and descended to Phobrong in a single day. This may not sound anything like a feat, but the reader should bear in mind the rapid descent from 18,500 feet to 14,500 and the sudden change in the atmospheric conditions. If there in anything worse than a never ending track that zigzags skywards, it is a rapid descent of more than five miles over boulders and loose gravel.

We pitched our camp at Phobrong on a grassy lawn that sloped down to the Pang-Kong Lake whence it rose again to the great heights of the Ladak Range, now wreathed in fleecy clouds.

Evening finds contentment everywhere ; the yaks quietly chewing the cud, the men huddled together over their ' All steel ' pipes, and floating on the evening air the soothing sounds of the hubble-bubble from the kitchen tent. Forgotten are the grievances, a bond of friendship such as never could have existed in the higher altitudes, has brought together the cook, the ' pot walluper ', the shikari and one or two parasites, ' " The Burra Saheb ' is quite a descent stick, and not what we thought him at 17,000 feet; the ' Chota Sahib ' uses some vile language but we know he doesn't mean it. Anyhow we are going back " '.

The cook firmly makes up his mind to give us a real change from the eternal ' estew '. Alas ! these resolutions vanish with the last pull off the hookah.

Our road now skirted the west shore of the Pangkong Salt Lake that lay between the outer ranges of the Ladak and Kara Koram Mountains. The Lake is the largest in these regions being nearly thirty miles in length and about five miles in breadth. Such is the intensity of the cold during winter in these parts, that villagers are able to drive herds of yaks and ponies across its frozen surface to the hill ranges opposite.

The Brown-headed Gull (*Larus brunneicephala*), a familiar bird in the Bombay Harbour and along the west coast of India, crosses over the Himalayas and breeds on such lakes. On our visit (June 8) the Gulls had attained their breeding plumage and by the size of their organs we concluded that the shingle banks were used as nesting sites.

About midway down the shore of the lake, we pitched camp in open bush-covered country and were fortunate in securing a series of the Tibetan Partridge, which have proved a new species and named by Col. Meinertzhagen as *Perdix hodgsoniæ caraganaæ*.

'Ladak birds,' he writes, 'are generally paler above, especially the chestnut nuchal collar. The dark brown markings on the upper parts of *P. h. hodgsoniæ* are replaced by chestnut markings in Ladak birds, though this is not invariable. In size they do not differ from *P. h. hodgsoniæ*.

Type in the Tring Museum: ♂, Shushal, 15,000 feet, Eastern Ladak, June 13, 1925.

Distributiæ. Shores of Pangkong Lake to Rupshu and Hanle. Is confined to the valleys where the Tibetan Gorse (*Cargan*) grows.'

(*To be continued*)

A LIST OF ORCHIDS, WITH SOME NEW SPECIES FROM THE HIGH WAVY MOUNTAIN (MADURA DISTRICT)

BY

E. BLATTER, S.J., PH.D., F.L.S.

(*With a plate*)

The following is a list of Orchids which were collected in the month of May 1917 by the late Prof. F. Hallberg and myself on the High Wavy Mountain at an altitude of 4,500 to 5,500 ft. The area examined measures about 12 square miles, covered with dense evergreen forest and some smaller patches of grass-land, apparently forest-clearings.[1]

Before publishing this paper I sent my MS. and specimens to Mr. C. E. C. Fischer of the Kew Herbarium who is just engaged in writing the continuation of the unfinished work of the late Mr. Gamble's Flora of the Presidency of Madras. As the next issue of the Flora contains the Orchidaceæ and as Mr. Fischer knows the Madras Flora by many years' practical experience in that Presidency, I could scarcely find anybody better qualified to criticize my list. Though I cannot agree on every point with Mr. Fischer's views, I am greatly obliged to him for pointing out a number of mistakes I had made. He even discovered a new species amongst my material which I had failed to recognize as such.

1. OBERONIA, Lindl.

1. **Oberonia Brunoniana**, Wight Ic. t. 1622.—Nos. 329, 330, ? 26551.

Distribution: W. Peninsula: Konkan, N. and S. Kanara, Nilgiris, Pulneys, mountains of Malabar and Travancore.

2. **Oberonia verticillata**, Wight Ic. t. 1626.—Nos. 26549, 26554.

Distribution: N. Kanara, Nilgiris, Pulneys, Travancore.

3. **Oberonia iridifolia**, Lindl. Gen. & Sp. Orchid. 15, var. **denticulata**, Hook. f. in Hooker Fl. Brit. Ind. v, 676.—*O. denticulata*, Wight Ic. t. 1625.—Nos. 331, 26550.

Distribution: Of variety: Nilgiris, Pulneys.

4. **Oberonia Lindleyana**, Wight Ic. t. 1624.—No. 26552.

Distribution: Nilgiris, Travancore Mts.

2. LIPARIS, Rich.

1. **Liparis viridiflora**, Lindl. Gen. & Sp. Orchid. 31.—No. 26546.

Distribution: Sikkim Himalaya, Upper Assam, Khasia Hills, Nilgiris.

2. **Liparis Wightiana**, Thwaites Enum. 295.—No. 26547.

Distribution: Pulneys, Travancore, Ceylon.

3. **Liparis sp.**—No. 26545.

Only one specimen in fruit.

3. DENDROBIUM, Swartz.

1. **Dendrobium nutans**, Lindl. Gen. & Sp. Orchid. 90 (including D. Jerdonianum, Wight Ic. t. 1644), var. **rubrolabris**, Blatter var. nov.—Sepala necnon petala alba, labium rubrum maculis purpureis.

[1] See this Journal, vol. xxv (Sept. 1917), p. 290.

The lip has 3 very high, close, crisped lamellæ. Margin of midlobe very strongly crisped. Nos. 335, 25808.
Distribution of type: Coorg, Nilgiris, Ceylon.

2. **Dendrobium nanum**, Hook. f. Ic. Pl. t. 1583.—Nos. 26523, 25810.—Flowers pale pink, except lip which has a purple spot on each side.
Distribution: Malabar.

3. **Dendrobium sp.** near **nanum**, Hook. f.—Too young for proper identification. —No. 25811.

4. Bulbophyllum, Thouars.

Bulbophyllum nilgherrense, Wight Ic. t. 1650.
The leaves are subacute, not retuse as shown in Wight's figure.—No. 340.
Distribution: Nilgiris, Malabar.

5. Cirrhopetalum, Lindl.

Cirrhopetalum Gamblei, Hook.f. in Hook. f. Fl. Brit. Ind. v, 778.—*C. Thomsoni*, Hook.f. l.c.—No. 332.
I intended to transfer this species to Bulbophyllum, following Smith: Bulbophyllum Thou., sect. Cirrhopetalum, in Bull. Jard. Bot. Buitenz., ser. 2, viii (Oct. 1912), 19–29. But Fischer tells me that Kränzlin, Schlechter and Rolfe have accepted Cirrhopetalum as a good genus, and he thinks that the unequal sepals make a good character to separate it from Bulbophyllum.
Distribution: Nilgris, Pulneys, Bababoodan Hills.

6. Chrysoglossum, Blume.

1. **Chrysoglossum Hallbergii**, Blatter, sp. nov. (*Orchidaceæ—Epidendreæ—Dendrobieæ*). Similis Chrysoglosso maculato, Hook.f. sed recedit ab eo habitu epiphytico, mento saccato, disco labii 3 lamellis prædito, bracteis multo longioribus.
Epiphytic. Pseudobulb 1-leaved, leaf with 5 large and very numerous close finer veins. Scape lateral, about 12-flowered, with 3 sheaths. Bracts longer than pedicel and ovary. Flowers pedicellate. Perianth-segments all 9 mm. long. Sepals and petals obovate-lanceolate to lanceolate-acute, the latter broader, all 3-nerved. The lateral sepals united to the upper half of the spur of the lip, forming a small saccate mentum, below which the proper spur may be distinguished, which is subcylindrical, slightly incurved and not quite 1 mm. long. Lip clawed, 3-lobed, midlobe much longer than the side-lobes, suborbicular, obtuse, with a very broad claw, base of claw minutely auricled, side-lobes subrectangular, obtuse. Disk with 3 very distinct lamellæ. Column slender, bent forward, winged in front, the wings becoming broader and thicker downwards, forming a long foot, each wing having a large auricle about half-way down. Anthers small, terminal, opercular, with a frontal cusp, 2-celled, cells distinct, hemispherical. Pollinia 2, free, subglobose, waxy.—No. 26488.
2. **Chrysoglossum sp.** Probably a form of *C. maculatum* Hook.f.—Epiphytic, not in flower. Found together with the new species, but the finer nerves are not so close, and the leaves are in tufts, not solitary on the pseudobulb.—No. 26487.
3. ? **Chrysoglossum sp.**—No. 26487.

7. Eria, Lindl.

1. **Eria braccata**, Lindl. Journ. Linn. Soc. iii, 46.—*E. reticosa*, Wight Ic. t. 1637.—No. 338.
Distribution: W. Ghats, Konkan, Nilgiris, Ceylon.

2. **Eria pauciflora**, Wight Ic.t. 1639.—No. 337.
Distribution: Nilgiris.

3. **Eria nana**, A. Rich. ?, but too incomplete for certainty.—No. 25809.

4. **Eria pseudoclavicaulis**, Blatter, sp. nov. (*Orchidaceæ—Epidendreæ—Erieæ, Sect. Hymeneriæ*). Distinguitur ab Eria clavicauli, Wall. foliis longioribus

non acuminatis, internodiis longioribus, racemo unifloro, bracteis oblongis acutis haud nervosis, sepalo dorsali elliptico-oblongo obtuso, petalis subobtusis.

Epiphytic. Stems tufted, clavate, terete, with numerous longitudinal fissures above, 20 cm. long ; last internode 7 by 1·5 cm., swollen in the middle, slightly oblique ; next internode 7 cm., thickest on top, the following 5 by ½ cm., cylindrical. Sheaths 0. Leaves 3, 16–17 by 4–4·5 cm., oblong-lanceolate, acute, coriaceous ; nerves numerous, stronger ones regularly distributed, between which there are a number of very fine close ones. Peduncle opposite the middle leaf, 22 mm. long, terete, pedicel solitary, strongly ribbed upwards, both thinly brown-pubescent ; at base of peduncle a small sheath ; at junction of peduncle and pedicel two large bracts which are olive coloured, oblong, acute, half-amplexicaul, glabrous, hardly nerved, one lower than the other ; opposite the upper is a small upcurved awn,possibly a reduced second pedicel. Flowers faintly fragrant, glabrous, mainly white, mentum tinged with pink. Dorsal sepal 15 by 6 mm., elliptic-oblong, obtuse ; lateral sepals very broad at base, 15 mm. long, triangular, falcate, subacute, reflexed, mentum 8 mm. long. Petals falcately oblong, 14 by 5 mm., subobtuse. Lip sessile at the base of the column, incumbent, much shorter than the lateral sepals, broadly obovate, subequally 3-lobed with the margins light-purplish fading inwards, all lobes slighly crisped, lateral lobes bent inwards, midlobe minutely white-puberulous. Disk with a white pubescent ridge, 2 mm. broad in the lower half, which portion has in front 2 small lateral calli, the upper half much narrower, yellowish, hardly reaching the subacute tip of the midlobe. Column white, bent nearly at a right angle to the axis of the flower below the stigma and produced into a long foot forming the broad mentum together with the lateral sepals, foot broadest at the bend, marked further out with a few faint buff spots. Stigmatic cavity broad, below the horizontal rostellum. Anther opercular, embraced by the flaps of the column, 2-celled, cells approximate at base behind. Pollinia 3 in each cell, connected by their bases, 2 much larger than the third, compressd, pyriform, pale cream-coloured.

Described from one specimen which was brought to Bombay where it flowered in the beginning of September 1917.—No. 554, kept in formalin at St. Xavier's College, Bombay.

8. Josephia, Wight

Josephia lanceolata, Wight Ic. t. 1742.—No. 333.

Distribution : Central Provinces, W. Ghats from the Konkan to Travancore, Ceylon.

9. Cœlogyne, Lindl.

Coelogyne nervosa, A. Rich. in Ann. Sc. Nat. ser. 2, xv, 16.—C. corrugata, Wight.

Side lobes of lip much veined inside with orange-yellow. The 3 raised ridges of the disk yellow in front ; rest of corolla white. Pollinia pale yellow. Wings of column orange.

Our specimen flowered in Bombay in September 1917.—No. 339.

Distribution : Nilgiris, Pulneys, Travancore hills.

10. Aerides, Lour.

Aerides cylindricum, Lindl. in Wall. Cat. 7317.—Nos. 122, 25801, 25806, 25807. Sepals and petals of No. 122 white, lip pale pink.—Not common.

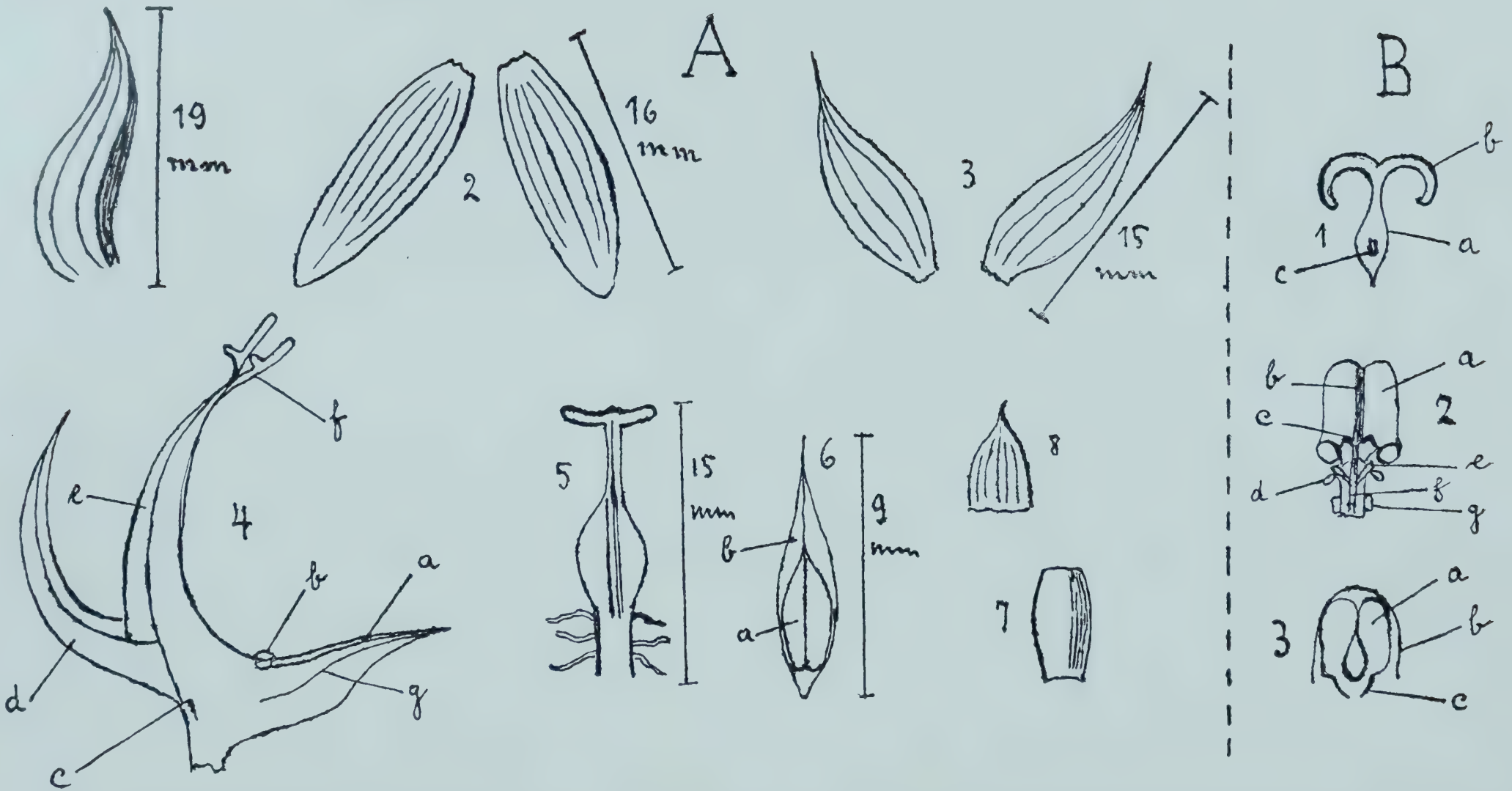
Distribution : From the Coorg Hills to Travancore.

11. Saccolabium, Bl.

1. **Saccolabium pulchellum**, C. E. C. Fischer.—*S. nilagiricum*, Hook. f. in Hook. Fl. Brit. Ind. vi, 60.—*Vanda pulchella*, Wight Ic. t. 1671.—No. 342.

Distribution : Nilgiris.

2. **Saccolabium filiforme**, Lindl. in Journ. Linn. Soc. iii, 36. The colour of the flower seems to vary a good deal. In Wight's plant they are rose-coloured, in



A. *Odontochilus rotundifolius*, Blatter, sp. nov. 1. Dorsal sepal. 2. Lateral sepal. 3. Petals. 4. *a*. Process of column. *b*. Calli. *c*. Base of anther. *d*. Connective of anther. *e*. Clinandrium. *f*. Rostellar arms. *g*. Lateral veins of process of column. 5. Lip. 6. Anther. *a*. Pollinia. *b*. Connective. 7. Ovary. 8. Bract.

B. *Disperis neilgherrensis*, Wight. 1. *a*. Midlobe. *b*. Side-lobes. *c*. Spur. 2. *a*. Rostellum. *b*. Stout midnerve of rostellum. *c*. Stigma *d*. Process of rostellum with gland. *e*. Lateral lobes of lip. *f*. Claw of lip. *g*. Papillose appendage. 3. Anther: *a*. Cell. *b*. Connective. *c*. Process of cell.

Ceylon plants orange with red stripes. Our flowers are bright brick-red, lip orange, midrib of petals very prominent, ending in a point short of margin, lateral veins very obscure, close to midrib.

Hook. f. (Fl. Brit. Ind. vi, 54) mentions expressly that the sac of Saccolabium is ' without a large scale or callus within under the column ' except in S. *longifolium*. There is one, however, in our specimens as well as in Fyson's t. 250 illustrating *S. filiforme*, Lindl. See also Wight Ic. 1685, text.

Fischer who examined some flowers of the same specimen could not find a trace of a callus. I presume that it is sometimes present and sometimes not. In any case Hooker's general statement about the presence of the callus will have to be slightly modified. No. 189.

3. **Saccolabium gracile**, Lindl. Gen. & Sp. Orchid. 225.—No. 26531.
Distribution : Ceylon.

12. Cleisostoma, Bl.

Cleisostoma tenerum, Hook. f. in Hook. f. Fl. Brit. Ind., vi, 73.

Sepals and petals green with purplish longitudinal markings. Lip white, side-lobes yellowish with purple markings. The whole flower, except the midlobe, sometimes assuming an orange hue in the same plant. Leaves 7-nerved. Rostellum 2-lobed at base, each lobe with a horizontal linear appendage ; in the space thus formed rests the gland.—Nos. 30, 25805, 25803, 25804.
Distribution : Nilgiris, Ceylon.

13. Anaectochilus, Bl.

Anæctochilus elatior, Lindl. in Journ. Linn. Soc. i, 178.—No. 834.
Distribution : Nilgiris.

14. Odontochilus, Bl.

Odontochilus rotundifolius, Blatter, sp. nov. (*Orchidaceæ—Neottiæ—Spiranthecæ*) Caulis terrestris nanus procumbens ; folia pauca, parva, rotundo-mucronata. Flores albi ; sepalum dorsale necnon petala apice brunnea. Sepala erecta, dorsale quidem 2 cm. attingens, 5-nervosum, lateralia autem 16 mm. longa, oblonga, 5-nervosa. Petala 15 mm. longa oblongo-acuminata subfalcata, 3-nervosa. Labium 14 mm. longum apice 2 lobis elongatis fere horizontalibus ornatum. Columna brevis appendice frontali praedita. Rostelli brachia longa, unoquoque brachio lobulo unico ventrali munito. Forma foliorum necnon sepala 5-nervosa hanc speciem a ceteris speciebus affinibus distinguunt.

Terrestrial. Stem nodose, procumbent, creeping below, bulbous-based-hairy, 15 cm. high. Leaves few, almost orbicular, mucronate, the largest seen 2 cm. diam., glabrous, midrib distinct on lower surface, stalk about as long as blade, bulbous-based-hairy, amplexicaul. Flower terminal, solitary, nodding ; bract broadly ovate-acuminate, as long as the ovary. Sepals erect (not spreading), green at base, rest whitish ; dorsal sepal 19 mm. long, concave-hooded, 5-nerved, tip reflexed, brown ; lateral sepals 16 mm. long, oblong, subobtuse, 5-nerved, connate at the base and concealing the minute spur of the lip. Petals 15 mm. long, oblong-acuminate, subfalcate, 3-nerved, white, tips brown. Lip white, adnate to the base of the column, base with a minute subsaccate spur ; claw broad, entire, 4 mm. long, with a few long hairs, then the lip is bulging out into 2 rounded lobes for a distance of 5 mm. and again contracting, after that narrow-linear for 5 mm. with 2 short elongate obtuse lobes spreading almost horizontally at the apex. Column short, white, frontal appendage of column cup-shaped, lanceolate-acuminate when seen from the side, lying in the folded claw of the lip ; calli small. Rostellar arms long, slender, each with a minute lobe on the ventral side. Anther lanceolate-acuminate, curved ; pollinia broadly lanceolate in outline ; caudicles long, slender. Ovary 5 by 2 mm., slighly broader upwards, densely pubescent.—Plate 1, A.

Described from one specimen which we found in damp evergreen forest. Seems to be very rare —No. 25802.

15. Spiranthes, Rich.

1. **Spiranthes australis,** Lindl. in Bot. Reg. t. 823.

Fischer thinks this must be a sport of *S. australis*, Lindl. = *S. sinensis*, Ames, Orchid. ii (1908), 53.

The flowers are polymorphous. The top flower is larger, sepals and petals obtuse, sepals minutely serrulate. Rostellum mucronate at tip. Rostellum of lower flowers smaller, minutely bifid at apex.—Flowers white, tinged with pink.

Found near top of plateau.—No. 26528.

Distribution : Throughout India, Afghanistan, N. Asia, China, Java, Australia, N. Zealand.

16. Zeuxine, Lindl.

1. **Zeuxine longilabris**, Benth. in Gen. Pl. iii, 600.

Differs from other known specimens in the colour of the flower : Sepals olive with white margins. Lateral petals and lip white with olive base. Column orange. Bract pinkish. Ovary olive with 3 lighter stripes. No. 26530.

2. **Zeuxine Blatteri,** C. E. C. Fischer in Kew Bull, 1927.

Sepals greenish with pale tips. Petals pale-pink. Sac orange. Limb white.

Found in damp evergreen forest.—No. 343.

17. Peristylus, Bl.

1. **Perristylus stenostachyus,** Krzl.—*Habenaria stenostachya*, Benth. Fl. Hongk. 362.—*Habenaria peristyloides*, Wight Ic. t. 1702.—No. 26507.

Distribution : Sikkim Himalaya, Khasia Hills, Tenasserim, Deccan Peninsula, from the Konkan southward, China.

18. Satyrium, Swartz.

1. **Satyrium nepalense,** Don Prodr. 26.

We found only one dry specimen in bare patches of the hill-top.—No. 344.

Distribution : Temperate Himalaya, from Kashmir to Sikkim, Khasia Hills, Deccan Peninsula, from the Konkan to Travancore, Ceylon.

19. Disperis, Swartz.

1. **Disperis neilgherrensis,** Wight Ic. t. 1719.—*D. zeylanica*, Trin. Cat. Pl. Ceyl. 91.

As many points in the morphology of this species are not, or only partially, known, I give a full description of our specimen :

A small plant, 7–11 cm. high, all glabrous. Tuber entire, 2 by 1 cm. Stem rather stout, fleshy. Leaf solitary, very rarely 2, situated about $\frac{2}{3}$ up the stem, broadly ovate, acute, sessile, cordate, subentire, 5–7-nerved, amplexicaul. Flowers few, subsessile, each with a leaf-like bract. Pedicel and ovary up to 15 mm. long. Dorsal sepal narowly lanceolate, 3-nerved, rather obtuse, forming together with the petals a concave hood 1 cm. long and as broad, only glued together, not united. Lateral sepals spreading, broadly falcately ovate, united for about 3 mm., 10 by 5 mm., subacute, with 5 nerves from the base 1, the central one more prominent, each with a small saccate spur about 3 mm. from the base. Petals broadly semilunate, subobtuse, with several anastomosing nerves and an oblique band marking the position of the dorsal sepal, margin minutely papillose, slightly waved, Sepals and petals white at base, rest greenish, veins purple. Lip : midlobe 3-lobed. Claw erect, confluent with column. Midlobe pendulous, resting on the claw, subacute, in the centre with a short, laterally compressed, obtuse, oblong spur which is slightly tomentose. The lip is folded along the side-lobes which, therefore, are channelled below, they are strongly curved downwards and papillose and yellow-tomentose above, united with the pendulous portion for some distance; the lower part of midlobe (before meeting its side-lobes) lies along the large rostellum, but is

not united with it; the side-lobes surmount the column. Lateral lobes of lip very short, spreading. Column resting on and united with claw of lip, horizontal and having 2 papillose appendages at the base. Stigma consisting of 2 small fleshy processes just above the place where the lateral lobes of the lip are situated. Anther posticous, erect, attached below to the conniving column and claw ; cells close together above, but distinct, with a short process below, appear to be open from the beginning. In front of anther and enclosing its margins lies the large rostellum ; it is emarginate at the tip, withering downwards with recurved margins and has at the base 2 hyaline flat appendages along which the caudicles of the pollinia rest and with a large flat deltoid exposed gland at its apex. Caudicles not twisted, bright yellow ; pollen-grains olive-green, 2-seriate, secund on the twisted axis, cuneiform, compressed. Ovary up to 14 mm. long, 6-ribbed, slightly twisted.—Plate 1. B.

Found among damp leaves in evergreen forest, not common. No. 345.

All the specimens mentioned in this paper are at Kew.

AN ACCOUNT OF THE PEARL FISHERIES OF TUTICORIN MARCH AND APRIL 1927

BY

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(*With four plates*)

This pearl fishery was held, under the directorship of Dr. B. Sundara Raj, M.A., PH.D., Director of Fisheries to the Government of Madras, in the months of March and April, 1927. The Government of Bombay had permitted me to go to Tuticorin to observe and study the different processes involved in carrying out a pearl fishery.

There have been many fisheries in previous years but never before was a fishery held on such a grand scale as the present one as regards the extent and the excellent organization of the camp and magnificent operations at sea.

The story of the pearl fishery will be best understood if it is described under three different aspects, the first of them dealing in outline with the life history and the habits of the pearl oyster, the second with the formation of pearls and the last describing in minute details the different operations of the fishery.

I. **Pearl Oyster.**—The celebrated pearl oyster of Tuticorin, known as *Margaritifera vulgaris*, belongs to the family of *Aviculidæ* having close affinities with Scallops (*Pecten*) and Mussels. It differs from Edible oysters in the possession of bundles of tough threads (byssus) by means of which it anchors itself to the substratum.

Some of the general characters of the family are as follows :—

'The shell is usually inequivalve ; the dorsal margin straight, often very long and forming anterior and posterior wings or ears ; the lateral teeth of the hinge line are much prolonged and may be inconspicuous ; the mantle lobes are not fused ; siphons are absent ; the foot is moderately long, tongue-shaped with a well developed byssus gland ; the posterior adductor muscle is very large and nearly central, the anterior adductor muscle absent.'

The internal characters need not be mentioned here.

Life History and Habits.—The Pearl oyster is unisexual and remains so till the end of its life unlike what has been observed in the edible oyster which changes its sex after each spawning period. It becomes sexually mature within the first two years of its life and spawns twice a year in the beginning of the South-west and North-east Monsoons. Its fecundity is enormous. Eggs are extruded direct from the oviducts by means of the suprabranchial passage to the sea and are fertilized in the open sea by spermatozoa emitted by ripe males.

Eggs undergoing development after fertilization become swimming embryos within a very short time. The latter pass through different stages such as trochosphere, veliger, etc., and are transformed within a week into spats, i.e., very tiny oysters with symmetrical shells and delicate byssus threads. Before the spat formation, the larvae or embryos are at the mercy of ocean drifts and currents which carry them in all directions. As soon as the spat is formed, it gets itself attached by means of the delicate byssus threads to any floating or rooted algæ. It seeks the shady under side of the branches and sooner or later drops off and sinks to the bottom being dislodged by shaking or by the disintegration of the floating weed. Once it is on the bottom it begins to grow in size, all the time being anchored firmly to the substratum by means of those byssus threads,

Though the anchorage is firm, the Pearl oyster is by no means a sedentary and helpless animal. It creeps slowly along the surface by means of its long and tongue-shaped foot when the byssus threads are damaged or uprooted. This oyster has got the power of forming over and over again byssus threads which are secreted by a certain gland situated in the foot.

The shell of this oyster continues to grow in length till the third or the fourth year of its life. After this period it thickens greatly by the deposit of nacreous material in its interior and especially in the neighbourhood of the hinge at the dorsal edge. This is the time of rapid pearl formation. The oyster tissues are then in the condition which lends to the secretion and deposition of limy material either externally by addition to the thickness of the shell or internally as successive coats deposited on any particle, such as a dead parasite, sand grain, diatom, a fragment of nacre, ova or excreta, which has given rise to the necessary stimulation. At about this time or a little later the oyster becomes fishable when it measures about 4 by 3 inches. If it is not fished at the proper time (which is a mysterious period) the oyster has got a tendency to disappear. Causes of its disappearance are not yet discovered.

Longevity of the oyster is not definitely known but it appears that it does not live beyond six or seven years.

Banks or Paars.—The grounds on which these oysters are found aggregated close together are known as Pearl oyster banks or paars (meaning rock or any form of hard bottom in distinction to 'manul' which indicates loose or soft sand). "The Pearl bank plateau is bounded for the most part by 10 or 12 fathom line. Outside the paars, the ground shelves away rapidly to 20 to 30 fathoms which marks the top of the steep slope down to the mud-floored abyss forming the central portion of the Gulf of Manaar. Along the line of this slope, soundings in some places jump in short distances to anything between 100 and 1,000 fathoms. Within 10 or 12 fathom line, on the other hand, the ground is for the most part very level." At Tuticorin a distance of 10 to 12 miles is run from shore before a depth of 10 fathoms is reached.

The surface of these plateaus is either sandy diversified here and there by outcrops of so-called rocks generally in the form of flat or slightly inclined ledges or low terraces, or entirely rocky with a mount of sand in crevices. The rock in the latter case may sometime be covered by a thin layer of sand which shifts from time to time with the currents.

The rock of the plateau may be grit stone formed of yellow tinted quartz sand cemented by carbonate of lime or it may be largely dead, worn and altered coral or it may be a shelly mass, an agglomerate of dead valves of pearl oysters and other molluscs.

'A certain amount of sandy bottom interspersed with harder tracts and with plenty of cultch, natural or artificial i.e., fragments of dead coral and of calcretes, broken shells lying on the sand is probably the most favourable ground. The cultch gives foothold for new broods of oysters and at the same time helps to stiffen the shifting sand and prevents in some degree the wash out and turnover of the surface which is caused by a heavy swell.'

These banks abound in rich flora and fauna besides the pearl oysters. The microscopic spores and embryos of these plants and animals form the substantial food of these oysters.

Enemies of the Pearl Oyster.—The Pearl oyster is a very delicate animal. Though it is found in shallow waters up to 10 to 12 fathom line within as many miles from the shore, the sea water in which it is found must be clean i.e., free from any sandy suspensions and also free from any dilutations of fresh water from the land. These two factors alone will kill the oyster.

Besides the above there are other causes of death of these oysters ;

(1) *Shifting of Sand.*—This shifting which buries oysters and kills them is caused by strong currents set up by the South-west monsoons and other storms.

(2) *Predacious Fish.*—Sharks, Rays and File fishes devour these oysters. Though enemies, they form a necessary link in formation of pearls in oysters. This connection will be explained later on.

(3) *Boring Animals.*—Boring sponges and boring molluscs, bore holes into the shells. The former allow parasites and sand grains to enter through the holes, into the soft body of the oyster and thus kill it indirectly, while the latter suck the soft parts through these holes and swallow them.

(4) Miscellaneous causes such as overcrowding, over-fishing and epidemic due to Protozoan or other parasites.

II. **Pearls.**—In India there is a popular belief that pearls are formed by drops of rain falling at a particular period known as *Swati*. At this time it is supposed that pearl oysters come up to the surface of the sea water, open their shells and wait for the drops. As soon as these drops have fallen into them, the shells are closed and the animals go to the bottom. These drops become afterwards pearls. Such and similar beliefs are still held by different communities all over the world.

Scientifically speaking, there are three important methods in the formation of pearls ;

(1) Grains of sand, minute fragments of nacre, etc.
(2) Pathological secretions.
(3) Cestode embryos.

any one of the above entering into the body of the oyster causes irritation and then stimulation to deposit pearly nacre around the source of irritation. This nacre is deposited by an epithelial layer derived from the ectoderm (skin).

Almost all the fine pearls found free in the body are formed by deposition of nacre around the cestode embryos which find entrance into the oyster. It will be very interesting reading if a complete life cycle of this pearl-stimulating cestode is described here.

'The adult worm (*Tetrarhynchus unionifactor*) from the body of a Shark or Ray sets free its numerous young embryos into the sea. Such free swimming embryos gain entrance with food currents into the body of the oyster. They are found in the mantle, in the gills, in the liver and also in the connective tissue of the body wall in an encysted or encapsuled condition. If these infested oysters are eaten by File fish (Balistes) Sharks or Rays, the cestode larvæ are transferred to the body of the new host where they begin to grow. These cestodes are then in a recognizable stage of *Tetrarhynchus* but they are not yet adult nor have they reproductive organs. It is not yet definitely determined whether these immature cestode forms reach their maturity in the same fish or in another new host, i.e., Shark or Ray which preys on the File fish.'

'In those oysters which do not become the prey of the File fish, the cestode larvae have no chance of completing their life cycle. They die and become encapsuled in the layers of pearl nacre deposited by the living tissues of the oyster upon the source of irritation caused by the cestode embryo which ultimately becomes the centre of a brilliant and costly pearl.'

Thus it will be seen from the above that the predaceous fish form a necessary link in formation of pearls. 'No rays, no pearls ; abundance of rays no oysters, as the latter are destroyed by the former. But Nature has somehow restored the balance between the oysters and the predaceous fish.'[1]

Different views as to pearl-formation can be best summed up in Prof. Herdman's words:—

(1) Majority of pearly excrescences on the interior of the shell are due to the irritation caused by boring animals. In exceptional cases a free pearl may be formed in this way. There is a device by means of which these blisters or excrescences are cut and filed into pearls of very low order. These pearls are then known as Vottu or Blister pearl.

(2) Minute grains of sand or inorganic particles form the nucleus of pearls under exceptional circumstances. When the shell is damaged, these sand grains get into the interior and supply the irritation that gives rise to pearl formation. These are known as Ampullar pearls.

(3) Many pearls are found in the muscles close to surface. These are formed around minute calcareous concretions, the Calcosperules, which are produced in the tissues and form centres of irritation. These are known as Muscle pearls.

(4) Most of the fine pearls found free in the body contain the remains of the cestode parasites (embryos). They supply the requisite irritation for pearl formation. These are known as Cyst pearls.

Valuation of Pearls.—Valuation of pearls is a very complicated affair. The principle underlying this valuation is to pass pearls through different sieves. Each sieve is round about 6 to 8 inches in diameter and 2 to 3 inches high with sized holes in the bottom. The size of the holes in each basket (sieve) is different. The pearls that do not pass through the holes of any particular sieve have a different value and different name. In this manner different pearls are valued and classified.

[1] *Report of the Ceylon Pearl Fishery, 1925-26.*



1. Pearl Bazaar guarded by Police.



2. A Corner of the General Bazaar, Pearl Fishery Camp.



3. Divers' Encampment.



4. Divers at Work.

Names of pearls depending on valuation, size, shape and lustre are different in different parts of India. If mentioned here, it will cause more confusion and will serve little or no purpose at all in this narration.[1]

III. **Pearl Fishery.**—A pearl fishery involves many operations, some at sea and others on land, but long before it actually begins, the banks or paars have been surveyed many times in order to investigate spatfalls as well as numbers of fishable oysters. If the survey results as to the quantity of fishable oysters, and if the valuation reports of pearls contained therein are satisfactory, it is then and then only decided to hold a fishery. In order to make it known to all concerned, it is thoroughly advertised in Burma, Ceylon and other parts of India and the world through various newspapers, so that rich pearl merchants will be attracted to the place. In the meanwhile divers are being recruited, fishing boats are being brought to the place and the camp is being constructed on the spot where the fishery will be held.

Fishery Camp at Silavathurai and its Administration.—The site of this pearl fishery camp known as Silavathurai lies at a distance of nearly two and half miles to the north of the town of Tuticorin. 'It is the time-honoured spot where fisheries from ancient Hindu and Portuguese days have been held.'[2]

The camp covers an area of more than 100 acres. The front i.e. the eastern portion of the camp extends up to the open beach, while the rear (western) portion lies amidst Palmyra trees. On the south side it is bounded by a series of small lagoons which separate the town from the camp, while to the north lies a piece of uncultivated land full of thorny bushes and cactus, a small back-water channel and a salt factory, a mile or so away from the camp.

On the beach are built huts or quarters for officers, visitors and the staff. A little towards the south, but facing the beach, are constructed offices including an auction hall in front of the old beacon. In the same line parallel with the beach but far away towards the south is built a Kottu (store) for Government shells, and still further away on the beach itself for nearly a mile are located series of huts known as Thotties for rotting oysters.

Just behind the offices is reserved an area for retail selling and cutting open oysters by retail buyers. The area known as Sales Ground is fenced with wire all round except at two opposite ends which are kept open for admission into and exit from it.

The pearl bazaar extends on both sides of the road which runs east to west from the Sales Ground. This bazaar consists of pearl shops opened by pearl merchants coming here from different places but mostly from Bombay. These shops are rented out to them and Government receive a good income out of it.

A road which runs at right angles to the west end of the pearl bazaar accommodates shops of green grocers and eating houses for various kinds of people who frequent the camp. There are also some cloth shops. These shops are also rented out.

There are two or three roads running east to west at right angles to the mid portion of the general bazaar on either side of which are built huts for divers, different sects occupying different areas. These huts are given free to these divers.

Behind all the above roads but a long way off towards the west are sunk eight tube wells which supply water to the whole camp. They are worked with a hand pump. Water is supplied in a bullock cart to the officers and the staff, but other people have to take water from the pump which is worked by Government coolies. A guard is placed at each tube well to see that no bathing, washing or polluting the water in any way is done. The water arrangements are in charge of a mechanic lent for the purpose by the Industrial Department of Madras.

In the north-west corner, but away from the tube wells and also from the camp, there are bathing places for divers and others. A contractor who is in charge of these places collects a small fee for every bath. One can see a crowd of bathers every evening when divers have returned ashore all tired and wanting a cold bath to refresh themselves.

The whole camp is well guarded by constables who are in charge of one Inspector of Police and his two assistants. Its health is also well looked after

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[1] The above account of the pearl oyster and the formation of pearls is mainly based on Prof. Herdman's Reports to the Government of Ceylon.

[2] *Report of the Pearl Fishery, Tuticorin, Madras, 1926-27.*

by Medical and Sanitary authorities. There is a small hospital with an out-door dispensary attached to it.

One Additional Superintendent who is recruited from the Revenue Department looks after administration of the camp. He goes round the whole camp twice a day morning and evening, supervising the general comfort.

The lighting is done by the department itself and it is in charge of the above officer. The roads are well lit with Kitson lights.

Peaceful and harmonious working of the whole camp reflects a great capacity for organization and tact on the part of the Director of Fisheries.

Operations up to Diving.—Nearly one thousand skin divers took part in this fishery. There were Christian divers, mostly local i.e., from Tuticorin, there were Mohamadan divers from a place called Kilakarai, now famous for efficient divers, and there was also in addition to the above, a sprinkling of Arab divers once famous for diving. These divers not possessing a boat of their own, had to hire a fishing boat to take them out to the pearl banks and bring them back ashore after the day's work. Every boat taking part in a fishery has to obtain first a pass from the Customs Department which (pass) is handed back to the same authorities after the fishery is over. These divers have also to hire men for lowering them into the sea and haul them and their baskets up during the period of diving. These men, known as mandacks, are really the crew of the boats doing additional work and earning extra money.

Nearly seventy-eight boats were engaged in this fishery.

Before the actual start from the shore which was at about four o'clock in the morning, the tindal of every fishing boat had to obtain a fresh permit every night from the Beach Master as to the number of divers and mandacks his boat was carrying to the place of fishing. The permits were made in different colours and boats were accordingly divided into several groups, those of each group having a permit of the same colour. The purpose of this device will be clearly understood when a certain operation i.e., the division of oysters at sea, is described later on.

Every night in the camp a gun was fired at 11 p.m., a second gun at 3 a.m. and the last at 4 a.m. when boats and divers were supposed to be ready for departure from the shore. When everything was ready, the boats weighed anchor and set sail for the place of fishing. If the winds were unfavourable, these boats were generally towed either by the Government Trawler *Lady Goschen* or a hired tug, for a distance of 10 or 12 miles to the places on the pearl banks already marked out for fishing by the Superintendent in charge of the Pearl Banks. Once the fishing boats arrived on the spot, they cast their anchors and the divers got ready for diving. By this time there was sufficient light for diving purposes.

Operations from diving to returning of divers ashore

Complement of each boat.—In each boat there were two classes of men directly concerned with diving, one of them being divers 10 to 12 in number and the other, as many mandacks. Besides the above, there was the tindal of the boat with six to twelve men as the crew according to the size of the boat. Sometimes the mandacks themselves constitute in number the crew.

Methods of Diving.—There appeared to be no standardized method of diving. 'The Arab divers had poles projecting over the sides of their boats by means of which they hoisted themselves out of the water by an acrobatic movement. They usually used horn clips on the nose and it was their custom to come to the surface hanging on to the rope with the left hand and not letting it go in mid water until they reached the surface.

'Most of the Tamil boats have temporary outriggers fitted to the sides of the boats from which the divers are suspended. The Tamil divers do not wear horn clips on their nose, but instead the nose is held between the thumb and the fore finger during the rapid descent to the bottom. They let go the rope in mid water after they have received an initial pull sufficient to bring them to the surface. The disadvantage of this method is that these divers reach the surface some yards away from their boats and also spend more energy in coming up.

'With rare exceptions both kinds of divers go down feet first with their feet resting on the stone sinker. A few of them are seen to hold the sinker near the chest and dive in head first.'[1]

[1] *Report of the Ceylon Pearl Fishery, 1925–26.*



5. Division of Spoils at Sea.



6. Bags of Oysters.
(Each bag contains 500 oysters.)



7. The Return of the Divers.



8. Washing the Pearl Oysters.

Every diver carries two ropes with him to the bottom one of them attached to the stone sinker and the other to the basket in which oysters picked from the bottom are raised to the surface.

Both these ropes are hauled by the mandack. As soon as the diver reaches the bottom, the stone sinker is let loose which is immediately hauled up to the surface. In the meanwhile the diver is feverishly busy in picking up the oysters or whatever comes to his hands and collecting them in the basket. He pulls at the basket rope whenever he wishes to rise to the surface for fresh air. Immediately the mandack begins to haul up the basket with the diver and within a few seconds both of them are brought to the surface.

After some rest the diver commences his work again.

Diving was done till a signal was given in the shape of firing of a gun or a shrill siren from a trawler when diving from all the boats had to cease at once. This took place at about 1 p.m.

In the meanwhile the Superintendent of the Pearl Banks was very busy in supervising the fishing boats. If the latter had strayed out of their places, they were towed back to their former or sometimes to new places. It is an advantage that all boats should work together on a particular spot. He also saw to it that diving ceased at once after the signal was given and that there was no illegal cutting of oysters before the division was made.

Division of Oysters at Sea.—As soon as diving ceased, boats began to approach, one by one, the Government schooners which were anchored on the fishing ground. Each side of the deck of these schooners flew a flag of a particular colour. Only those fishing boats approached that particular side which had permits of the colour of the flag flying on that side. This device saves a lot of worry and labour and provides a check on the boats and the divers.

On each side of the deck were placed two officers one for making divisions of the oysters brought by the divers and the other for checking and sealing the divers' shares in gunny bags. There were nearly half a dozen menials to help these officers.

As the boat came alongside the schooner, every diver, one after another, handed his collection to the officer who made three equal divisions, giving one to the diver and appropriating the remaining two on behalf of Government. In the meanwhile the checker put the diver's share in a gunny bag, sealed it and handed it over to the particular diver who went back to his boat. When all the divers got back their shares and the tindal received his old permit filled in with new details and countersigned by these officers, that boat was ready to go back to shore. Other boats were dealt with in a similar way. They were all ready now to go back. They reached the shore from two to three hours in fair weather from the time they got back their permits.

Sometimes it was very difficult to make divisions at sea owing to the high winds and choppy seas. Under these circumstances divisions were made on land after the boats had gone back under escort and deposited their collections in the Government Kottu or store.

The fishing boats arrived ashore in groups or one by one as the case may be and there was usually a huge crowd on the beach to welcome them.

The staff of the Beach Master was very busy on the beach when the boats arrived. They were scrutinizing the sealed bags of divers, getting back the permits already issued to them overnight and searching the boats for any misappropriated oysters. When they were satisfied, they allowed the divers, the mandacks, the crew and the tindal to go ashore.

Retail Selling and Retail Buying.—As already stated above, every diver has to pay the tindal and the mandack, the former for the hire of the boat and the latter for the services rendered at sea. He paid both the people in kind. He made six equal divisions of his share, retaining four of them and giving the remaining two to the tindal and the mandacks respectively.

These people now retired to the sales ground to sell their oysters. Retail buyers could buy them from one oyster upwards. The average retail price varied from twenty to forty oysters to a rupee. On an average a diver made about ten to twenty rupees a day.

A retail buyer cut open his oysters in another part of the same ground, anxious to see what his oysters contained.

In the meanwhile the Government transport boats arrived with the Government share which was handed over to the Kottu manager. These oysters had been already counted and bagged, five hundred in each bag, at sea. They

remained in the Kottu till they were delivered next day to those who had bought them at the public auction.

Public Auction.—A public auction was held every night at 8 or 9 p.m. in the auction hall. Half an hour or so before the auction began, a gun was fired to apprise prospective bidders of the event.

The auction hall was built on the central portion of a raised platform. Inside the hall were seated the Director and his staff, while in the open the public waited for the auction to begin.

The Director sat by himself on a raised platform, while his staff consisting of voucher makers, checkers and treasury clerks sat in front of him facing the public. There was a bamboo railing separating the public from the staff.

At the appointed hour the auction began, nobody was allowed to bid for less than one thousand or more than twenty-five thousands oysters. One of the peons standing in front of the staff, facing the public, announced the numbers of the oysters Government had for sale that particular day. On an average it amounted to one lakh and fifty thousand oysters daily.

Bidding per thousand went on till a certian price became stable for some time when some bids were accepted at that price. The price usually ranged between rupees thirty to fifty per thousand. Those whose bids were accepted at that price were admitted one after another into the hall where every one of them was required to get a voucher containing his name and the number of oysters he had bought. He presented this voucher to a treasury clerk who wrote the same details in his ledger and received a deposit, generally 1/10 of the whole amount of the purchase and gave a receipt for the same.

Bidding went on in the manner described above, till all the oysters of that day were sold out.

Next day the buyers presented their deposit receipts to the cashier in the treasury and got receipts for full payments which they presented to the Kottu manager. The latter gave them delivery of their goods.

On an average Government got a net income of Rs. 5,000 to Rs. 6,000 per day. But this income depended on various factors. Fair weather, calm sea, favourable winds, no under currents, warm day so that divers found it comfortable to dive, presence of efficient divers, place for fishing on the banks rightly located, pearls properly valued, presence of bidders and pearl merchants, good sanitation in the camp, absence of strikes, etc., all these conditions, individually as well as collectively increased the income or decreased it if any of them was adverse. Presence or absence of these conditions makes or mars pearl fisheries.

Rotting of Oysters in Thotties.—After the delivery of the goods, the buyers took their loads of oysters to their respective Thotties. Use of these Thotties was auctioned and Government got a good income out of it.

These Thotties were located on the beach far away from the camp, since they might become the source of an epidemic like Cholera as the oysters were being rotted in them. The four walls of each thotty were constructed of bamboo thatties with a small entrance but it was open to the sky. Each hut or thotty measured about 30 × 30 × 8 ft.

In these thotties then, the oysters were dumped in heaps for rotting purposes. Various agencies worked together for macerating or rotting the soft parts of these oysters. Heat engendered by the heap produces the optimum conditions under which various kinds of flies, mostly Calliphora, Lucilia and Sarcophaga, lay their eggs or larvæ. The latter which are voracious feeders of offal complete, with the help of bacteria, the maceration within four or five days. The soft parts are now turned into homogeneously pulpy material which emits vicious and repulsive odour.

After the fifth day these oysters or whatever remains of them were washed in a small dug-out or a tin bath or in a still smaller vessel according to the number of the oysters to be washed. After stirring or churning the contents and throwing away empty shells, the container was filled to the brim with sea water and kept over night. The next morning the superboyant liquid was slowly decanted and the contents again washed. This process was repeated so many times that a fine powered stuff was left behind. It was then spread out on a black piece of cloth and left there for drying. After it was thoroughly dried, a vigorous search for pearls was made on the spot or the whole stuff was taken home or to a shop where thorough search was made at leisure.

Pearl Bazaar.—There were sixty to seventy pearl shops or huts located on both sides of the main road. These shops were rented out to pearl merchants.

In these shops pearls were sold or bought or merely exhibited for show. In some of the shops fine holes were drilled into pearls which were then sewn into threads and were exhibited for sale. There were also people in this bazaar who bought blisters of the pearl shells and made cheap pearls out of them by careful filing.

Lastly my cordial thanks are due to the Director of Fisheries and his whole staff of the Pearl Fishery for the courtesy shown to me and for the trouble they underwent in taking me over all the operations involved in this Fishery. I also thank the Government of Bombay which allowed me to study this Fishery on the spot.

MODERN MUSEUM METHODS

BY

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Part I

(*With six plates and five text figures*)

Since one of the main objects for which a Museum is established is the 'diffusion of instruction and rational entertainment among the mass of the people', it follows that, apart from the purely scientific research and investigation which it carries out, the collections which are open to the public in its galleries, however rich, important and complete they may be, are only of real value to the extent to which they are made use of by the public and to the extent to which the public is able to benefit by the instruction and entertainment they are intended to afford.

Now the attitude of the public to the museum might often be expressed in the words of a certain New England farmer who, after enumerating the many virtues of his deceased wife, concluded by saying 'somehow I never liked the woman'. The public realizes more or less that the museum is an institution intended for its benefit but somehow does not like it. May not the reason for this attitude be explained by the fact that many museums are dehumanized institutions, completely lacking in attractiveness because of their unsympathetic treatment of the public and their unsympathetic methods of presenting their treasures?

Shortly after arriving in New York, I read an article in one of the Sunday papers dealing mainly with the work the Museums were doing for the people of the country. 'In America to-day,' the writer pointed out, 'the Museum fills the role of educator, entertainer and nursery companion; it has ceased to be a dusty warehouse of antiquities and has become a bright and cheerful instruction centre for the community.' After a few months spent working in and visiting many of the Museums in the country I realized more clearly the truth of his contention. Like everything else in American life, the Museum has developed into an institution with the motto 'service to the public'. The national spirit is expressing itself in these rapidly growing institutions—efficiency, gaiety, and democracy—these characteristics already differentiate the museums of America from those of other lands. One finds efficiency in their careful study of the comfort of the visitor while in the museum galleries and in their almost perfect methods of charting, casing, and labelling. One finds vividness and charm in their methods of exhibition, and democracy in the wide appeal they make to the public at large. Art and Science are learning to work together. The Science Museum calls on the artist for 'atmospheric effects of nature' and the Art Museum looks to the scientist to arrange its treasures in some intelligible progression. The result is the creation of museums which are really attractive to the masses, of museums which look to and receive public support. The impression one receives is that these

museums are unique in their history, progress and purpose; they cannot be compared with kindred institutions in the old world. Their appeal is not so much to the advanced technician or craftsman as to the man in the street. Except in the case where qualified guides conduct parties of visitors over its galleries, the teaching of the museum is silent teaching, and to be successful this teaching demands an effort on the part of the visitor. How far is this effort forthcoming? Now one might say that 90 per cent. of the people who visit a museum visit it mainly for pleasure and with the majority the message, the museum has to offer, loses much of its meaning unless it can provide something which arouses and holds interest. To deluge people with facts and to offer too much to their attention results in getting very little of it. The story of the monkey who was unable to get his handful of nuts out of a jar until he had dropped some of them has its application here. The neck of the jar is as large as the public interest, no larger—to grab too much attention is to lose it. To get the public to look at and absorb what you offer you must drop some of the nuts. One cannot teach people by marshalling whole series of facts before them. It is the principles that matter; facts will soon be forgotten while the principles remain. In offering the visitor principles which are new and unknown to him it is necessary to commence with something that is familiar and known to him. Our understanding and acceptance of a thing depends much on what we already have in our consciousness. Introduce something which has no connection with our past experience and we are not interested. To hold our interest there must be a large ingredient of the familiar with the unfamiliar. Edward Fisher in speaking of museums and their work said, 'The great purpose of Museums is to stimulate the observant powers into action. The educational value of museums will be in exact proportion to their powers of creating new thoughts in the mind'.

The object of the museums is therefore to lead the people to better ideals and to offer them new view-points in a way which they can understand and appreciate. The appeal is made more to the senses than to the intellect but it is made in such a manner that in addition to mere attractiveness it offers food for thought which is the first step to a higher and more intellectual ideal.

There are many ways of telling the story of nature. Why not choose the beautiful way? The way which leads from an appreciation of its interest and its beauty to an understanding of its meaning. It is the method which will make the widest appeal. A second reason is the obtaining of public support. By giving the public something which it can understand and appreciate and something which it wants, the museums succeed in rousing its interest and ultimately its support. And in this the American Museums have been completely successful.

A study of the methods adopted by museums in the United States in serving their public would perhaps repay the Museums of other countries. The stress and strain of modern life, and the demand that it makes on the time and attention of the average wage-earner, does not leave much time for such side issues as Art and Natural History. It is a condition that is becoming increasingly prevalent not

only in America but also in the older countries. Dr. Van Straelen, the Director of the Natural History Museum, Brussels, with whom I discussed this aspect of the question believed that the democratic spirit of modern times necessitated a change in the attitude of museums. The old museums were aristocratic, their show galleries were merely in the nature of a concession, but modern conditions necessitated a change in this policy. The museums were becoming more and more dependent on public support, on money voted for them by the people's representatives, and unless museums did something for the people the money would not be forthcoming. 'Applied science will find its votaries and its supporters' continued the Doctor, 'but for pure science we will have increasing difficulty in finding money. We arrange our galleries on the plan of a text book where specimens, models and explanatory labels trace in outline the various classes of the animal kingdom. This type of exhibition was necessary and useful for the more serious students, but the great majority of our visitors are not serious students and for them we want something else. There must be some 'light houses' in a gallery to draw their attention and rouse their interest.'

At the Natural History Museum, Berlin, radical changes are being made in the character and nature of the exhibits. There, too, the museum is making a bid for popular interest and support by the ntroduction of methods of exhibition which appeal to the lay visitor. For if the institutions which stand for the cultural development of the people are to succeed in their mission, it has become necessary for them to alter their standards, to break down their aloofness and restraint—that attitude of mind which looks on the visiting public as something in the nature of a nuisance, and come down to a more sympathetic consideration of the people's wants. Some may object. Why appeal to peoples' wants? Their wants may be stupid, childish or even positively mischievous. What we must appeal to is their reason. Professor Overstreet in his interesting series of lectures on 'The Influencing of Human Behaviour' gives us the answer 'No appeal to reason can ever be successful if it is not also an appeal to a want'. An understanding and appreciation of the truth of this axiom will save much time in argument. If one of the main motives of a Museum is education not of the few but of the mass, and if this education is to be effective, it requires the rousing of the popular interest in its activities as a first step, and it is the duty of the Museum Director to make his museum worth being interested in, to give his museum such vitality and pertinence that people will want to be interested in it, will want to visit it, and will realize the necessity of supporting it, and though the people may want something quite inferior, his problem is to get them to want something worthwhile, and to give them the opportunity for these more worthwhile wants to multiply and grow.

I will now pass to a consideration of the methods adopted by Museums in the United States and on the Continent to attract and maintain public interest and support. The subject may be divided under two headings :

1. The Museum Galleries as a whole.
2. The nature and methods of arrangement of the exhibits.

1. General Treatment of Galleries

The principal factors which react on the mind of the visitor on entering a gallery are—

1. The architecture and colour of the walls and the show cases,
2. The show cases themselves and their general arrangement,
3. The exhibits.

The third factor being the most important, it necessarily follows that the first and second factor should be subordinate to the most effective presentation of the third.

We will leave the question of architecture aside for the present. The museum curator is rarely in a position to decide the architectural requirements of the building he is to use. The question of the colour of its walls is a matter which might easily come within his province to decide. It is not difficult to realize the importance of colour as a means of attraction. Even as children we were attracted rather by colour than by form. We retain this impulse throughout life, only we temper it by a new desire for a pleasing arrangement or harmony of colours. Our objective should therefore be a pleasing colour scheme, that harmonious blending of show cases and walls which will be most effective in the presentation of the exhibits shown in the gallery.

Colour Schemes.—As a general rule quiet colours should be utilized. The choice of colour will depend largely on the lighting of the room and the objects to be displayed, but the rule in its selection should be the avoidance of an obtrusive scheme which will draw to itself the attention of the visitor. At the Brooklyn Museum, the show cases and walls in the hall of Invertebrates were painted a bluish-grey ; the effect produced was restful and pleasing. In the Mammal Gallery at the Natural History Museum, Altona, Hamburg, the colouring of the walls and show cases was very harmoniously conceived. In the main Mammal Hall the walls had a 6′ 6″ dado of dusky slate blue relieved with a faint grey stripe, the upper portion of the wall was carried out in Rejane green [1] and the contrasting areas of colour were divided by narrow black lines, the pedestals of the show cases corresponded in colour to the dado, their upper framework was in black, while the backgrounds were grey stippled with green. In the Bird Gallery in the same museum the dado of the hall was in nickel green, the upper surface of the wall cream buff with a white area where the wall joined the ceiling. The pedestals of the show cases were treated in a similar tone of green as the dado, while their frames were black.

The selection of a colour scheme should be governed by the type of exhibit shown in the gallery. Certain exhibits require quiet tones, others more brilliant ones to give them their full significance, particularly where colour in the exhibits themselves is wanting. A rather daring and original colour scheme is to be seen in the Ethnological Gallery at the Brooklyn Museum. This hall is divided by its architecture into three sections, the columns supporting the ceiling forming the divisions. Each section is confined to illustrating the arts and crafts of a distinct race. In the first section the

[1] Ridgeway's Colour Standards, pl. xxxiii.

show cases were green, in the second royal blue and in the third rose pink. The plinths of the adjoining pillars were coloured to correspond with the show cases. Thus in the same hall one had three aisles of show cases painted in different colours. After passing through several galleries where drab or neutral tones predominated, this original colour scheme had the effect of renewing and re-arousing one's attention. The eye was greeted by something fresh and colourful and the effect was not unpleasing. Rejane green makes an excellent background for animals and birds. It is used in the galleries of the Munich Museum and is perhaps the most successful colour tone I have seen used in any Museum in connection with these types of exhibits.

Atmosphere.—The colouring of the walls and the show cases to produce a desired 'atmosphere' is another point which deserves consideration. In the Invertebrate hall at the Brooklyn Museum, where the majority of the exhibits were illustrative of life in the sea, the blue grey colouring of the walls gave a marine note to the gallery which was further accentuated by mural paintings depicting seascapes in various quarters of the globe. In the new Fish Hall at the American Museum, the colour of the walls is grey with a stippling of waved blue lines giving them a watery effect; the backgrounds of the cases against which the fishes are shown, had the same colour motif in a slightly darker tone, the whole object being to give a 'marine atmosphere' to the gallery. Artificial light through lanterns of greenish glass increased this effect. The whole question of the colour in a museum gallery is a phase of museum work which requires study, it is now in the experimental stage. It marks an advance in museum methods. Its object is to please and attract the visitor by creating an atmosphere which will produce a subtle reaction on his mind and in any way prepare him to enjoy and appreciate what he sees.

Mural Paintings.—A further development is the decoration of the walls with appropriate mural paintings. Many museums are now adopting this method of decorating their galleries. We find galleries of Art, Archæology, Geology, Ethnology, Zoology and Botany decorated in this manner. Apart from their purely decorative effect, murals have a distinct educational value. They are a clear and simple means of transmitting ideas—they are tools for communicating thoughts, stimulating interest and arousing feeling and emotions. Where a range of exhibits is shown which requires a mental effort on the part of the visitor to clothe them with the interest they merit, these pictures will supply the required stimulus —will supply vividness and drama to what might otherwise have been a barren theme. In the hall of the Age of Man in the American Museum, where the exhibits illustrate successive stages in the history of man, the dry bone atmosphere was to a large extent relieved by the beautiful murals adorning the walls of the gallery. The fleshless skull of the Cro-magnon man springs into life in the mural painting depicting the Cro-magnon artist at work painting his procession of mammoths in the cavern of Font-du Gaume in France. At Altona, Hamburg, the walls of the Bird Gallery were ornamented with paintings of individual birds or groups of birds; such subjects



By courtesy *Amer. Mus. Nat. Hist., New York.*

PART OF DOMED CEILING OF BIRD GALLERY, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.



By courtesy *Buffalo Soc. of Nat. Sciences.*

MODEL OF EXHIBITION HALL

as geese in flight or a soaring eagle gave a charming and appropriate setting to the exhibits. The vaulted ceiling of the Bird Gallery at the American Museum of Natural History is painted to represent a sunset sky against which we see various birds in flight—actual specimens are used and as these recede further into the distance they are substituted with painted birds, the gradation in size and the perspective is cleverly maintained and the effect altogether is realistic and charming. (*Vide* Plate 1).

There are certain points to be remembered in decorating the walls of a gallery with murals. Firstly, a mural must preserve the flatness of the wall it decorates. It should not mar the architectural lines or destroy the even level of the wall's surface by giving it an effect of contours. Mr. Charles Knight, one of the most successful animal painters in America told me that he preserved the desired flatness in his murals and yet gave them an effect of roundness by painting them always with the light coming up from behind, so that the objects were more or less silhouetted against the background and yet had a feeling of depth.

Then again as regards colour tones, these should always be ruled by the type of exhibit in the gallery. Where one is exhibiting skeletons or fossils and such like colourless material, a certain latitude in colouring is permissible but in a gallery where the exhibits are themselves colourful, restraint is necessary in the colour of the murals so that a harmonious effect might be obtained. In every case the murals should be a subordinate feature and should not become the centre of attraction. In the old African hall at the American Museum the murals illustrating scenes of African life were done completely in sepia. In the new Reptile Gallery which contains many beautiful and vividly coloured groups, the murals are being painted in quiet shades. Small colour sketches of these murals were first done to scale, subsequently a full sized copy was done on cheap muslin, this painting was fitted to the walls to see whether it harmonized or clashed with the exhibits ; certain colours were then reduced and other heightened till the desired effect was achieved. I have written at some length on this subject because I believe that our museum offers an excellent field to our school of mural painters in Bombay, it will afford them the opportunity of showing their skill to the people of their own city and of having their work exhibited where it will be seen by thousands. Natural History offers them an endless range of subjects while the Archæological and Art sections could also be made a venue for their skill.

Arrangement of Show Cases.—The second factor which draws the attention of the visitor on entering a gallery are the show cases and their arrangement. A gallery crowded with tall show cases whose massive wood work and external finish makes them unduly conspicuous carries with it a decidedly forbidding aspect—it creates a feeling of heaviness and artificiality which can be thoroughly depressing, and its effect upon the visitor is to repel rather than attract. The overcrowding of the gallery with show cases and the cases with exhibits appals the visitor who quickly realizes that he will never be able to absorb a tenth part of what is offered him.

The arrangement of the show cases and the type of show cases

to be used in a particular gallery will depend largely on the architectural features of the room, its lighting and the nature of the exhibits to be displayed, but the general attractiveness of the room and the effect of its arrangement upon the visitor is a point always to be seriously considered. The accompanying photograph (Plate II) illustrates a model exhibition hall designed for the new Buffalo Museum. It will be seen that the cases are let into the walls of the room—they are of the 'built in' type, their breadth varies according to the nature of the exhibits to be displayed. In the present instance the cases along the sides are 18" deep, those at the head of the gallery which are intended for groups are 6 feet deep. This is one method of arrangement which is very successful and very attractive. It gives an air of spaciousness even to a small room and is adaptable to any type of exhibit.

A second method of arrangement is seen in the new Reptile Hall in the American Museum. The floor of the gallery is occupied by a series of small metal-framed box cases none of them exceeding 4 feet in height, the walls on one side have a series of 'built in' groups (*vide* Plate III) while the opposite wall has a series of vertical cases arranged in the form of alcoves. The use of only low cases for the floor gallery is an advantage in that, there is nothing to obstruct the view of the visitor from the gallery as a whole and that atmosphere of cumbersomeness and artificiality produced by an assemblage of tall show cases is largely obviated. The use of the centre of the gallery for some artistic and dominating exhibit is an effective method of adding to its attractiveness. This is seen to good effect in the design for the new hall of African Mammals at the American Museum of Natural History, New York, where the central exhibit will take the form of a magnificent group of African Elephants mounted as a memorial to the late President Roosevelt. In the Mammal Gallery at the Altona Museum, the centre of the floor is occupied by the skeleton of a horse mounted on a high pedestal, the walls are lined with 'built in' cases, while the main floor space is occupied by low box cases illustrating life histories of mammals.

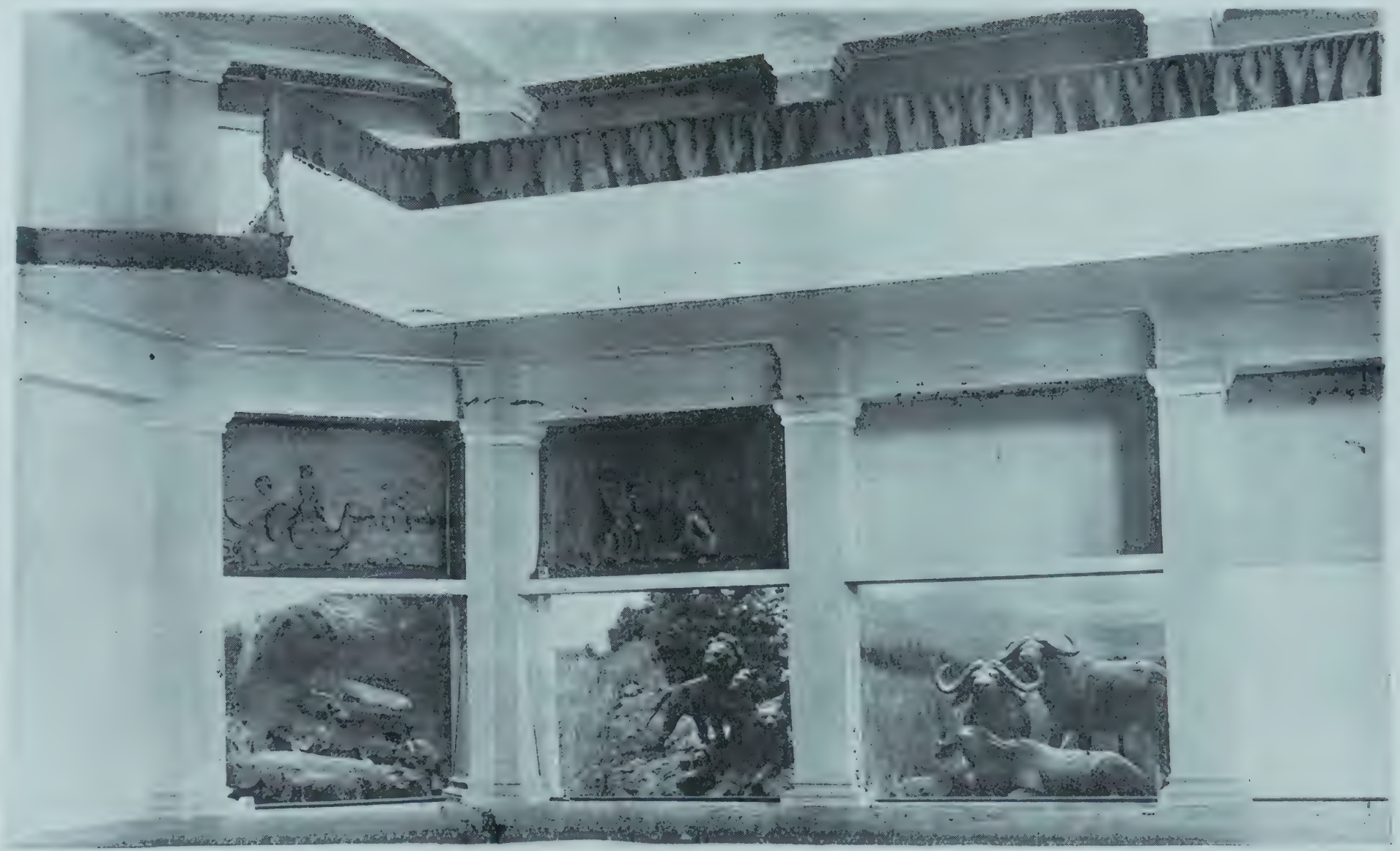
It has been shown that by introducing the 'built in' type of show case, the necessity for large cases on the floor of a gallery, is largely obviated. High show cases on the floor of the gallery obtrude on the visitor and obstruct the view, while the use of the floor space for low cases only gives airiness and spaciousness to the hall and facilitates guarding. The arrangement of cases as alcoves while it is effective in focussing the attention of the visitor on one part of the gallery at a time, has the disadvantage of making the policing of a gallery difficult. The use of a prominent central exhibit acts as a 'light house' to attract the visitor.

Show Cases.—In addition to the problem of attractiveness the Museum Curator has another problem—a very important problem —and that is the prevention of fatigue. The visitor sees the museum galleries not only with his eyes but also with his protesting feet. Visiting a museum takes time and while the visitor takes his time it will be more difficult for his brain to take in new impressions, if the rest of his bodily organism is crying out for attention. Benches with restful backs are a great necessity in a museum.



By courtesy *Amer. Mus. Nat. Hist., New York.*

NEW REPTILE HALL, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, SHOWING 'BUILT-IN' GROUPS.



By courtesy *Amer. Mus. Nat. Hist., New York.*

MODEL OF NEW HALL OF AFRICAN MAMMALS, AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.

The supply of seating is a necessity which is quite often made conditional on available space, but if the comfort of the visitor is to be seriously considered, then the provision of seating accommodation must be made an essential feature in the planning of a gallery.

At the Altona Museum, Hamburg, I saw a space beneath a window between two show cases effectively used for a seat. The second source of fatigue is eye strain, caused firstly because the objects shown are placed either too high above or too low below the level of the eyes, secondly because the exhibits are placed too far from the eyes and thirdly because objects are placed in long monotonous rows.

The structure and design of museum show cases in which museum exhibits are shown are an important factor in helping to remove many of these disadvantages.

The older type of show cases were characterized by their heavy

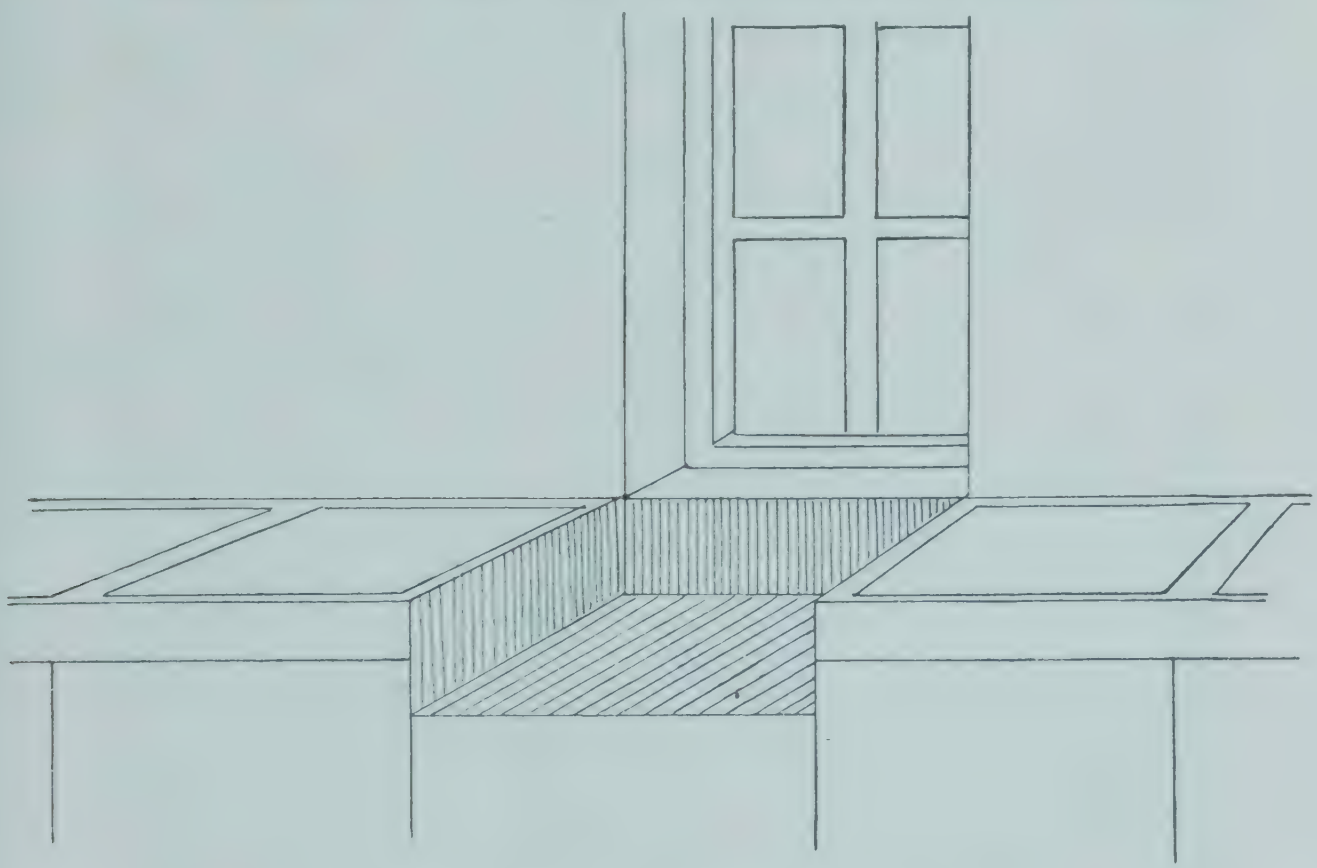


FIG. 1. WINDOW SEAT FOR VISITORS, ALTONA MUSEUM.

wooden frames, their ornate dust-catching design, abnormal length, height and depth, low bases, horizontal sashes obstructing the view and hinged or sliding doors. All of these features were a disadvantage from the visitors' view point. The modern museum case is distinguished by its narrow framework, reduced length, depth and height, its relatively high base which does away with the necessity for stooping, its large area of plate glass, no obstructing sashes and easily removable knock-down sides instead of hinged or sliding doors.

All museum cases may be classed under two headings, i.e., cases in which the exhibits are shown on a horizontal surface (horizontal or desk or table cases) and cases in which the exhibits are shown

on a vertical surface (vertical or wall cases) a comparison of the advantages of the two types yields the following results :—

Vertical case.	*Horizontal case.*
Maximum of exhibition space with minimum or floor area.	Maximum floor space with minimum exhibition area.
Clean glass (vertical glass is rarely touched by the visitor).	Soiled glass (horizontal glass is leaned upon and touched by every visitor).
Comfort for the visitor.	Discomfort, the body must be bent at a fatiguing angle to see the exhibits.
Well and evenly lighted objects, absence of eye-strain.	Visitor obstructs the light as he leans over the case.
Adaptable for any kind of object.	Can only be used for small objects.

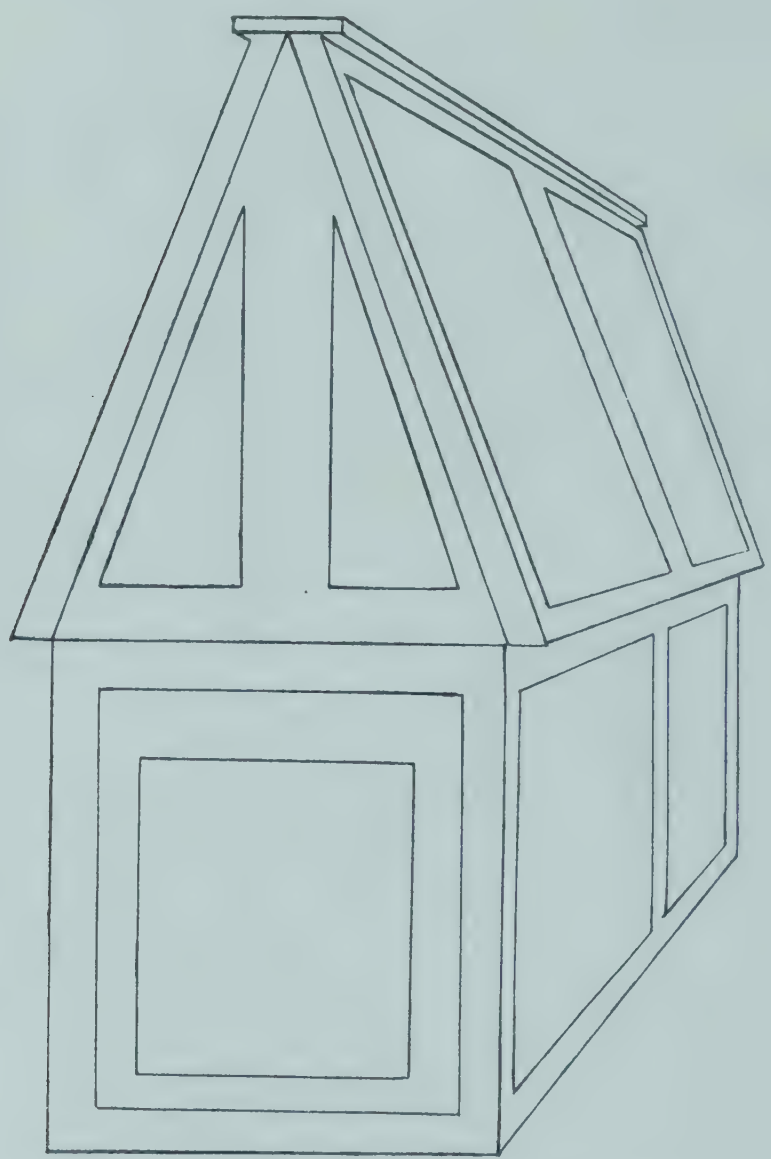


FIG. 2. TYPE OF DESK CASE IN USE IN THE GEOLOGICAL GALLERY, SOUTH KENSINGTON.

Owing to its many disadvantages the tendency to use the horizontal or desk case is steadily decreasing, as exhibition cases of the vertical type appear to be the most practical and economical for use in a museum gallery. A very practical substitute for the ordinary type of horizontal or desk case is the type of case illustrated in the accompanying diagram; by increasing the height of the case and subsequently the angle of the slope a larger exhibition area is made available without the occupation of additional floor space. The exhibits are thrown into better relief and the objects more evenly lighted, the glass is not leaned upon and the necessity for stooping is obviated. This type of case is in use in the Geological gallery at South Kensington, London. The case has a solid base which provides storage accommodation. The solid base has been much in use in museum show cases as it provides storage accommodation for exhibits not on display. Where a sufficiency of storage accommodation is not available, this is imperative though not always convenient, the disadvantage of the use of the high solid base for horizontal cases is that it detracts from the appearance of the case, is more expensive and makes policing of the gallery more difficult. On horizontal cases of the desk and table type, where the base is 32″ from the ground, the use of a leg base is preferable.

In arriving at the most suitable height for the base of a case the comfort of the visitor should always be taken into consideration. The placing of small objects a few inches from the floor level, as is often done in museums, is perfectly useless as the visitor would either have to go on hands and knees or bend down at an uncomfortable angle to see them, and this he is usually unprepared to do with the result that the exhibits so placed are rarely looked at. It would be better to sacrifice this space and limit the area available for exhibition to a suitable height from the ground where the exhibits would have a better chance of being looked at. The eyes of the average person are 60″ from the ground, the most comfortable visual distance averages 1 foot, the body may be lowered 15° without stooping. To prevent eye strain on the part of the visitor and the necessity for excessive stooping the bases of all desk and table cases should not be lower than 32″ from the ground and the objects within these cases should not be further than 2-4″ from the glass. In wall cases, the height of the base should not be lower than 24″ and the depth of these cases should not be in ordinary circumstances exceed 18″ while the height at which objects are shown should not exceed 62″.

The modern museum group requires a special type of case. The most effective case for the purpose is the type which is 'built in' and shows none or very little framework, the group being viewed as through a window in the wall of the gallery.

This type of case is particularly suitable for large habitat or zonal groups, but the possibility of its use will depend on the architecture of the hall, and in the construction of the modern museum galleries special provision is made for the installation of these built-in cases. The accompanying photo (Plate IV) shows series of built-in groups in the design for the Hall of African Mammals of the American Museum of Natural History, New York

Lacking requisite architectural facilities, group cases may be installed on the floor of a gallery and built in the alcoves formed between large floor cases. One such group was recently installed in our Museum. It is built between two large floor cases. It is 14 ft. in length, 7 ft. deep and 11 ft. high—the window measures 6 ft. × 4 ft.

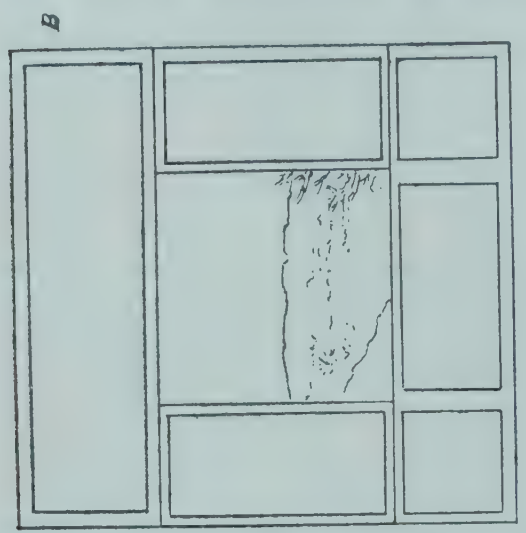


FIG. 3. Front view of Group Case. The panels on each side may be used for photographs or transparencies.

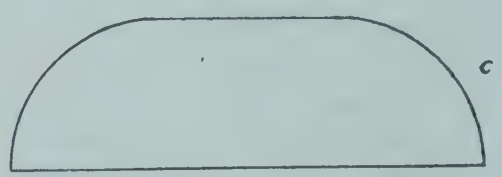


FIG. 4. Ground Plan of Group Case showing curve of Background.

As regards dimensions of these cases the most satisfactory rule is to have the length double the depth. As regards the background its main portion is flat but where it approaches the sides of the case it takes a gradual curve. The sides of the case should not be too long as it is difficult to avoid a 'strained' angle in the objects painted on it.

The ceiling or top of the case should be made as high as possible so that on looking at the group the visitor does not see the line where the painted background meets the top of the case. Reflections from outside the case generally mar the effect of many museum groups. To avoid reflections, the volume of light within the case must be greater than the volume without, and in groups of this type artificial illumination from within is nearly always necessary. By its use any desired lighting effect may be achieved. The lights are generally placed behind the upper portion of the front panel of the case. To avoid shadows and to shed a diffused light within the case, the reflectors of the lamps are directed towards the top of the case from which the light is deflected on to the objects below, or the light may be thrown on to a white painted board attached on hinges and placed immediately in front of the lights. By fixing this board at any required angle the volume of light reflected into the case can be controlled.

Reflections may be further reduced by fixing the front glass of the case at an angle, the degree of the slope being one inch to every foot of height.

As regards the construction of the curved background this may be done as follows. A form with the required curve is built by running up 2″ × 4″ joists which are held together with cross bracings (Plate V). This form is then covered over with pieces of



By courtesy *Amer. Mus. of Nat. Hist., New York.*

CURVED BACKGROUND IN COURSE OF PREPARATION FOR A GROUP AT THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.



By courtesy *Field Museum, Chicago.*

A CASE OF BIRDS SHOWING THE SHELFLESS METHOD OF EXHIBITION.

plaster board which are screwed into it. The plaster board is made by running plaster into flat or curved moulds as required and introducing layers of fibre and burlap into the plaster before it has set.

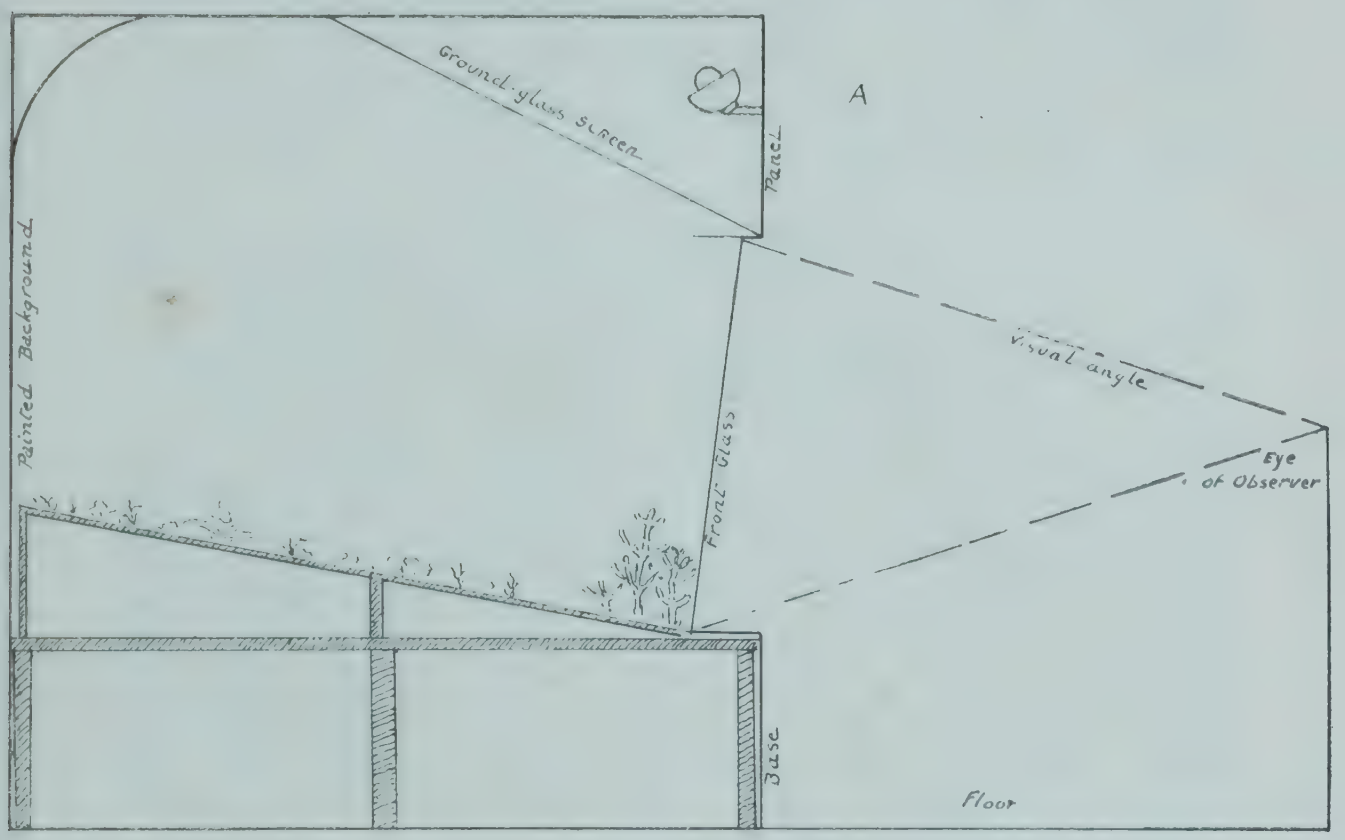


FIG. 5. Side view of Group Case.

When the whole form has been covered with plaster board the joints between the boards are filled with plaster, the whole surface is then sand papered and coated with shellac and when dry painted with two to three coats of white zinc. An alternative method is to cover the form with wire mesh, machè is then forced into the mesh and spread evenly over it. It is then shellacked and allowed to dry—when dry a second layer of wire mesh and machè' is laid on and then a third, each layer being shellacked and allowed to dry before the next one is added. It is then white leaded and covered with muslin as previously described. The photograph illustrates a group case in construction at the American Museum of Natural History, New York. A third method is to cover the curved form with strips of $\frac{1}{2}'' \times \frac{1}{8}''$ wood, then coat the whole surface with shellac. When dry, mix varnish and white lead to a syrupy solution, strain it through close-meshed wire netting and brush it over the surface doing one section at a time, covering each section as it is brushed with a layer of muslin which must be rolled on quite smooth. When dry the whole surface is coated with white lead—a good quality of white lead must be used—the poorer qualities turn yellow after a time and have a bad effect on the painting.

Smaller groups are constructed on the same principle and will often be found more practicable where conditions of space make the installation of large groups impossible—a consecutive series of

small groups illustrating the life histories of small mammals, birds, reptiles, fishes or insects can be effectively arranged along the walls of a gallery.

For the small museum one can do much more with small groups and show much more than with large groups. The background of these groups, if curved, can be made of cork lino screwed to a curved form, or of card board. At the Colorado Museum the backgrounds of the cases consist of coloured photographic transparencies on ground glass—the photograph illustrating the actual environment of the species forming the subject of the group.

Shelves.—In many museums the use of shelves within the cases is being done away with because they tend to produce a monotonous lineal form of arrangement. The shelf is being replaced by the individual bracket which supports the specimen against the background of the case. Most objects shown in museums lend themselves to this style of exhibition. The accompanying photograph (Plate VI) shows a case of birds in the Field Museum, Chicago, where the customary shelf has been substituted by the bracket. The Shrosbree bracket, a simple and efficient contrivance, which can be accommodated to both small and large objects will be found most useful for the purpose. It is supplied by the Public Museum and Library, Milwaukee, Wisc. The use of the bracket offers greater freedom of arrangement and better use of available space—the objects are brought into sharp relief against the background and an even distribution of lighting is assured. The labels are either fixed to the pedestal supporting the specimen or are placed in metal holders screwed into the back of the case.

We are adopting the shelfless method of arrangement in our Bird Gallery to very good effect.

For the background of our case we have used a screen made of 2 thicknesses of 3 ply wood fitted into a frame within the case so that the screen with the exhibits on it is removable.

In arranging the birds on a screen it is first necessary to decide how many birds are to be shown on the screen and the amount of space each specimen will occupy—space being left if necessary for subsequent additions—for this purpose rough sketches are made on the screen indicating the position of the bird. In arranging the specimens a lineal or monotonous arrangement should be avoided and an attempt should be made to arrive at a free and harmonious picture of the screen as a whole. When its genera design has been completed the mounted birds are fixed to the screen so that changes in arrangement if necessary may be made. When this is completed the specimens are removed and the whole screen is well sand papered and then painted with three coats of flat oil paint. The colour is applied with an air brush—petrol is used as a medium. This ensures a fine even flat coat of colour. Divisions between families are indicated by fine strips of beading. Variety may be given to the exhibits by introducing individual painted backgrounds showing the environment of a particular species and by the introduction of nests, foliage, etc. The labels are held in metal holders screwed on to the screen and coloured in a tone similar to the background.

(*To be continued.*)

BOMBAY NATURAL HISTORY SOCIETY'S MAMMAL SURVEY OF INDIA, BURMA AND CEYLON

Report No. 46

ON A COLLECTION FROM TOUNGOO, BURMA

BY

T. B. Fry,

South Kensington Museum.

Collection	...	...	No. 46.
Locality	...	...	Toungoo District.
Date ...	...	...	November 1926–February 1927.
Collected by	...	...	Mr. J. M. D. Mackenzie, I.F.S.

The collection made by Mr. Mackenzie in the District of Toungoo is valuable in that it supplements those made by him in Prome and Pegu, and serves to illustrate fairly well the fauna of the country north of those districts and adjoining the Shan States; in fact the work done by him in these three districts covers a considerable area which was left untouched by the Mammal Survey. Although a good many animals known, or supposed to exist in Burma, as noted by Mrs. Lindsay when reviewing the survey work, have so far eluded capture, yet the general fauna of this country is fairly well known, and to this knowledge Mr. Mackenzie has contributed in no small measure.

The present collection represents 14 genera and 18 species none of which are actually new, but there are many specimens which were much wanted, notably *Tomeutes ph. phayrei*.

Macaca mulatta, Zimm.

The Rhesus

(Synonymy in No. 16.)

Toungoo, ♀ 1.

Specimens of this monkey were included in the collections made in Prome and the Shan States respectively, by Messrs. Mackenzie and Shortridge, so that its existence in the intervening district of Toungoo was more than probable, still it is satisfactory that this has been proved. Blanford stated that this species was known throughout Upper Burma and as far south as Bombay in India proper. On the one hand no specimens were found in Tenasserim, Burmah, nor on the other in Dharwar, Kanara, etc., S. India, during the Mammal Survey operations consequently it may be inferred that this macaque has not wandered further south than about 18° N. latitude, and the limits of its habitat have now been fairly well established.

Cynopterus brachyotis angulatus, Mill.

The Malay Short-nosed Fruit Bat

(Synonymy in No. 17)

Toungoo, ♀ 1.

Corresponds in all respects with specimens from Tenasserim and the Mergui Archipelago.

Scotophilus castaneus, Horsf.

The Chesnut Scotophil

(Synonymy in No. 17)

Toungoo, ♂ 2, ♀ 5.

Hitherto recorded only from the Malay Peninsula, Tenasserim and the Mergui Archipelago; it is therefore noteworthy that it occurs so much further north.

TAPHOZOUS LONGIMANUS, Hardw.

The Long-armed Sheath-tailed Bat.

(Synonymy in No. 6)

Toungoo, ♂ 1, ♀ 2.

The male specimen differs considerably from the two females in colour being red instead of dark brown, but not in other respects. A similar variation has been observed in specimens from the Central Provinces.

TUPAIA BELANGERI BELANGERI, Wagn.

The Burmese Tree Shrew

Toungoo, ♂ 1.

Specimens from Pegu and Prome were identified by Mr. Thomas as true *T. belangeri*, and this one tallies with them in fur and size of skull. It would appear that this species is confined to the above mentioned area since Mr. Thomas has separated into sub-species the animals found north and south of it, naming them respectively *T. bel. siccata* and *T. bel. tenaster*.

VIVERRA ZIBETHA, Lin.

The Large Indian Civet

This specimen appears to be a true *zibetha*. Mr. Wroughton gave the names *V. z. picta* and *V. z. pruinosa* to specimens from Chindwin and the Shan States respectively, but they differ so slightly from *zibetha* that it is doubtful if they will ultimately be accepted as subspecies.

PARADOXURUS BIRMANICUS, Wr.

The Burmese Palm Civet

(Synonymy in No. 16)

Toungoo, ♂ 1.

A young specimen, but the black lines on the back by which it is distinguished from *P. niger*, are clearly marked.

PETAURISTA CINERACEUS, Blyth.

The Tenasserim Brown Flying Squirrel

(Synonymy in No. 29)

Toungoo, ♂ 1.

Blanford considered this Burmese Flying Squirrel to be identical with the very similar, though rather larger, animal *P. philippensis*, but this name is now held to apply to a southern Indian form. There are considerable differences in colour notably in the tails which are grey in *cineraceus* and black in *philippensis*. The Society is indebted to Mr. Mackenzie for three other specimens from Pegu and Prome, no others having been obtained by the Survey.

RATUFA GIGANTEA, McCl.

The Assam Giant Squirrel

(Synonymy in No. 14)

20 miles N. of Toungoo, ♂ 1, ♀ 2.

CALLOSCIURUS FERRUGINEUS, F. Cuv.

The Burmese Bay Squirrel

(Synonymy in No. 16)

25 miles N. of Toungoo, ♂ 1, ♀ 1.

TOMEUTES PHAYREI PHAYREI, Blyth.

Phayre's Squirrel

(Synonymy in No. 14)

5 miles E. of Toungoo, ♂ 1, ♀ 2.
7 ,, ,, ♂ 3, ♀ 3.
40 ,, ,, ♂ 1, ♀ 5.
30 ,, ,, ♂ 2, ♀ 2.
15 ,, ,, ♂ 1.
11 ,, ,, ♂ 1.

No true specimens of *T. ph. phayrei* were obtained by the Survey; those recorded in Report No. 14, being subsequently recognized as *T. ph. blanfordi*. The former are more highly coloured above and below, while the dark stripes on the under sides are absent or much less accentuated in the latter.

TOMEUTES PYGERYTHRUS, Geoff.

The Irrawady Squirrel

(Synonymy in No. 29)

30 miles west of Toungoo, ♂ 2, ♀ 2.
20 ,, ,, ♂ 1.
40 ,, ,, ♂ 1, ♀ 5.

Variations in colour, from a bright olivaceous to a dull grey, are very noticeable in these specimens; this is due no doubt to slight local differences in environment (such as thick or open forest), as they were all taken within a comparatively few miles of each other.

TAMIOPS MACCLELLANDI, Blyth.

The Striped Burmese Squirrel

(Synonymy in No. 14)

5 and 7 miles E. of Toungoo—♀ 1 and ♂ 3.

Tamiops m. barbei was obtained from the Shan States, Prome, Mergui Archipelago and Tenasserim, thus indicating that Toungoo is probably about the southern limit to which *macclellandi* proper extends.

GUNOMYS VARIUS, Thos.

The Malay Mole Rat

(Synonymy in No. 17)

Toungoo, ♂ 1, ♀ 1.

It may perhaps be worth while to point out that Toungoo is the most northerly district from which *G. varius* has been recorded; but as this rodent may easily have been carried northward by river-boats, etc., up-country correspondents of the Society (if there are any) might be asked to keep a look out for it.

RATTUS CONCOLOR, Blyth.

The Little Burmese Rat

(Synonymy in No. 16)

20 miles north-west of Toungoo, ♂ 1.
Toungoo, ♂ 7, ♀ 3.

RATTUS RATTUS KHYENSIS, Hinton.

The Shan Tree Rat

(Synonymy in No. 1)

20 miles north-west of Toungoo, ♀ 1.

In the earlier reports all the common house-rats received from Burmah were recorded as *R. r. rufescens* variety white under parts.

RATTUS RATTUS RUFESCENS, Gray.

The Common Indian Rat

(Synonymy in No. 1)

Toungoo, ♀ 2.

CANNOMYS PATER, Thos.

The Bay Bamboo Rat

(Synonymy in No. 20)

25 miles N. of Toungoo, ♂ 2, ♀ 4.

These specimen are undoubtedly *C. pater*. Geographically they should belong to one or the other of the subspecies *C. c. plumbescens* or *C. pater*, made by Thomas, and the general colour clearly indicates that they should be classed as the latter.

A PRELIMINARY REPORT ON THE ANATOMY AND LIFE HISTORY OF THE COMMON EDIBLE BACKWATER OYSTER, *OSTREA MADRASENSIS*

(*A paper read before the Indian Science Congress, Lahore, January, 1927*).

BY

S. T. MOSES, M.A., F.Z.S., F.R.A.I.

(*With 2 plates*)

This backwater oyster, common in Madras Presidency in all estuaries and favoured spots along the coast, owes its widespread presence to its being generally unaffected by a long range of variation in the salinity of the water it lives in ; a sudden onset of fresh water, as during floods, however kills thousands annually. Being commoner than the fresh water mussel, it may with advantage be used as a type for dissection in the class room.

The anatomy of the Tuticorin backwater oyster was one of the earliest items of research I did for Mr. Hornell, and later I had opportunities to examine oysters from Pulicat, Ennur, Cochin, Cannanore and Calicut. In the plankton collections of these places I found occasionally the trochophore and veliger stages of the oyster. These notes are presented in this form not because they are complete but that others with greater facilities may fill up the gaps in them, e.g., among others, trace in the laboratory the complete life-history from the egg to the spat.

Mr. Hornell in 1909 believed this species to be identical with the Ceylon oyster identified as *Ostrea cucullata* and said it was closely akin to the American *O. virginica* and stated that the two seemed to be geographical races of one species. *O. cucullata* is, however, the rock oyster which is characterized by the deep ridges of the shell ending in dentate edges which interlocked tightly when the valves came together. In 1910, however, Mr. Hornell differentiated the Sind species with a white muscular scar, from ours which has a purplish-black scar, but said that both appeared to be related to the Portugese mud oyster *O. angulata*.

The Chilka Lake oyster once named *O. gryphoides* var *cuttackensis* is now called *O. virginiana* by Vredenburg who says all our backwater oysters present no difference to the American species. Hornell agreed with Vrendenburg in 1917. H. B. Preston, the expert in charge of the publication of the volumes on Mollusca in the 'Fauna of India' series, declared in 1916 the extremely variable backwater oyster of the East and West Coasts as *O. madrasensis*. The close similarity of our species with the American in its anatomy and life history may justify its being named *O. virginiana* var *madrasensis*.

External appearance.—Nothing can be seen externally except the hard shell the sharp ends of which cut the feet of coolies and others

wading on oyster beds. The shell, white and flinty in appearance, is covered by a thin cuticle which when fresh is slimy to the touch on account of its being encrusted with muddy algal felting. Though slipper is the typical shape, variation is the rule, as oysters are of irregular growth habit the shape depending on age, overcrowding and other conditions of life.

The shell as in all Pseudo-lamellibranchs is inequivalve. The valves are united anteriorly by a dorsal hinge ligament which being elastic keeps the shell agape. The attached valve, the left, is bigger and more convex and gives lodgment to the whole body while the free right valve being flat functions as a lid.

The thickness of the shell also varies. Laminations and roughly concentric lines of growth are seen externally. The latter start from a swollen knob, the umbo, which as in other bivalves is the early shell. It is recognizable by its dark color. The left valve grows faster than the right.

The interior of the shell is like porcelain and white in color except for the muscle scar and some patches along the margins where it is purplish or purplish-black, with a touch of red.

When a piece of shell is broken off and the fracture examined there are seen the three usual layers, a thin outer horny cuticle, a thick—the thickness varies according to the varying number of strata forming it at different places in the same shell—layer composed of small columns of calcium carbonate set close together and a third thin layer containing purplish and brown pigments in some parts. It is the thick middle layer which is responsible for the reputation of oyster shell grit to cure hens of laying soft eggs.

Soft parts.—To examine the soft parts, the oyster should be opened gently taking care not to damage the delicate organs. To get specimens in a completely relaxed condition, they should be killed overnight in a weak solution of Chloral hydrate. Soaking in alcohol facilitates the dissection of nervous and other systems.

To open an oyster insert the point of a stout knife in the posterior margin at a point about midway in the length. Then gradually push the knife in helping this by slightly rocking the blade sideways. Then when the knife is far enough pushed in cut through the muscle and separate the free valve from the other.

The body thus exposed is seen to conform to the shape of the valve. It is coated by a mantle which as in all bivalves is divided into two flaps which enclose all the internal organs as if in a curtain. It secretes the shell. Its free edges, purplish or dirty brown in color, are fimbriated and bear two rows of very highly sensitive short tentacles. Healthy oysters, when gaping, respond at once to the slightest touch of the mantle edge with a needle by at once tightening the valves.

Anterior to the muscle lies the visceral mass made up mainly of the light colored reproductive organs and the dark digestive glands. The visceral mass of spent oysters is dark colored, which prejudices some, but wrongly, against using such oysters as food.

Digestive system :—Anterior to the gills and between them and the hinge are the two pairs of fleshy palps which enclose the oval

mouth. Food particles are brought in currents set by the action of the ciliated gills and palps. The direction is easily seen by sprinkling powdered carmine in the gills of a freshly opened oyster. The mouth leads through a short œsophagus into a stomach with thick but translucent walls. The dark green liver around the stomach sends many ducts to it. From the stomach leads the intestine which bends on itself when at the end of the muscle on its ventral side and coming back near its starting point describes a circle round the stomach and goes out as the rectum to the dorsal side of the muscle, to open out by a funnel-shaped anus. The rectum does not as in the fresh water mussel, traverse the ventricle and so the way to the heart is not through the stomach here. A crystalline style—absent in spirit specimens—is seen in the first (pyloric) arm of the intestines. The walls of the intestine and rectum are double induplicated, as may also be seen from the imprimature on the fæces.

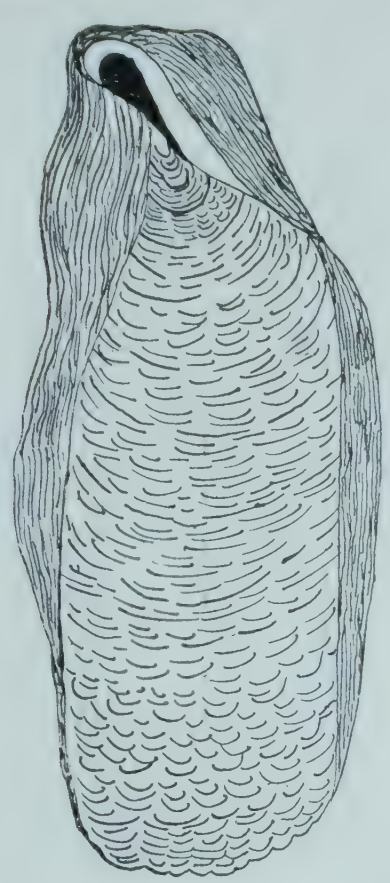
The food of the oyster is mainly diatomic and is found in the plankton of the water where it lives. About half the stomach contents consists of unrecognizable vegetable debris but the following were recognized :—Biddulphia, Rhizosolenia, Chætoceras, Coscinodiscus, Pleurosigma, Navicula, Ceratium, Foraminifera, Peridinians, Dinophysis, sponge spicules, setæ of Polychæt larvæ and Daphnids.

The enemies of the oyster are legion and they are active at all stages of its life. Apart from some, e.g., other molluscs, barnacles and aquatic flora, which crowd its beds to its disadvantage, there are active enemies like crabs (*Scylla serrata*), starfishes (*Luidia maculata* and *Astropectim*), shellfish (*Murex tenuispina*) and the boring sponge (*Clione vastifica*).

The oyster is edible, but Europeans who take it raw and in its natural juice should see that the source is not a sewage contaminated bed. The danger, though real, especially in a country where washing after evacuation is done anywhere, is exaggerated as oysters digest and kill injurious bacilli. Oysters however muddy their original habitat, become clean if placed for some days in a wholesome current and in fact in the Madras Aquarium clumps of live oysters when placed in tanks rendered the water less turbid and more crystal-clear. Once a dozen oysters from a suspected source as well as a dozen clean ones were sent to the King Institute, Guindy, for bacterial examination and both were declared free.

Vascular system.—Anterior to the muscle and between it and the visceral mass is a transparent thin-walled sac, the pericardium, containing the heart. There are two auricles and one ventricle. The ventricle does not, as in Lamellidens, embrace the rectum. To make out all the vessels, sections of hardened specimens are more satisfactory than dissection or even injection. The aorta after leaving the ventricle divides into two, one to supply the muscle and the other to the visceral mass. The blood from these organs go to the gills and after aeration flow into the auricles. The blood is colorless.

The gills.—Hanging down into the space between the two lobes of the mantle are two pairs of gills. Their ventral edges are free.



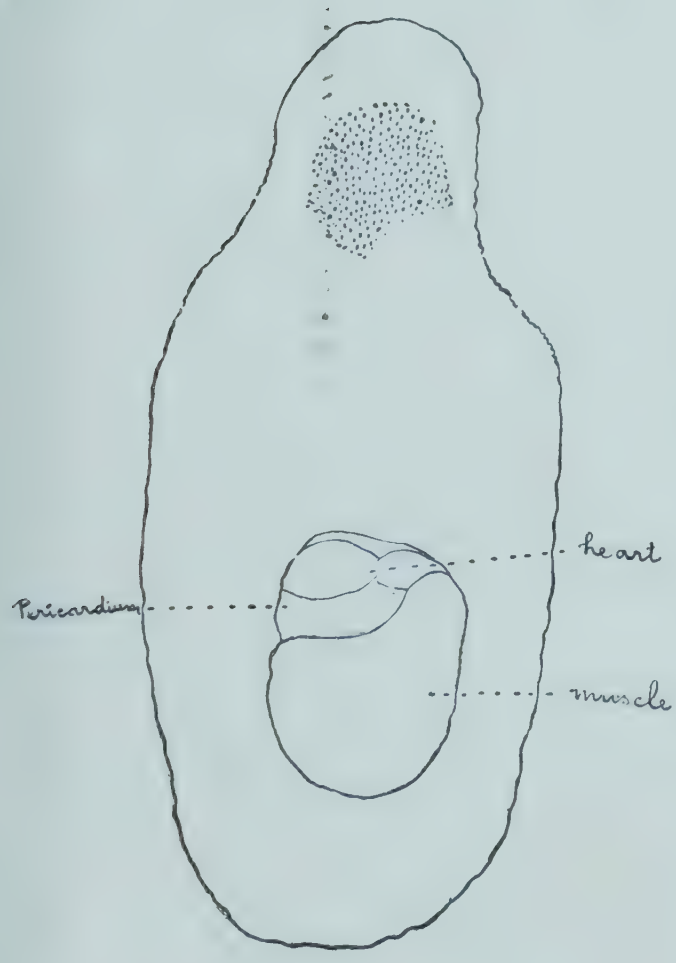
Ostrea madrasensis
External view

i.



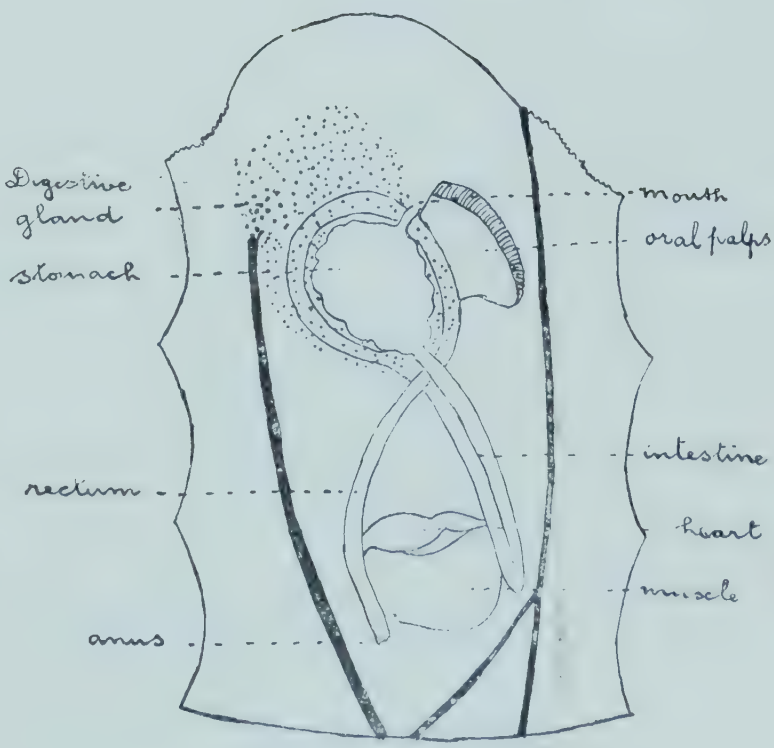
The free right Valve
under side.

ii



The Soft parts
(Body)

iii

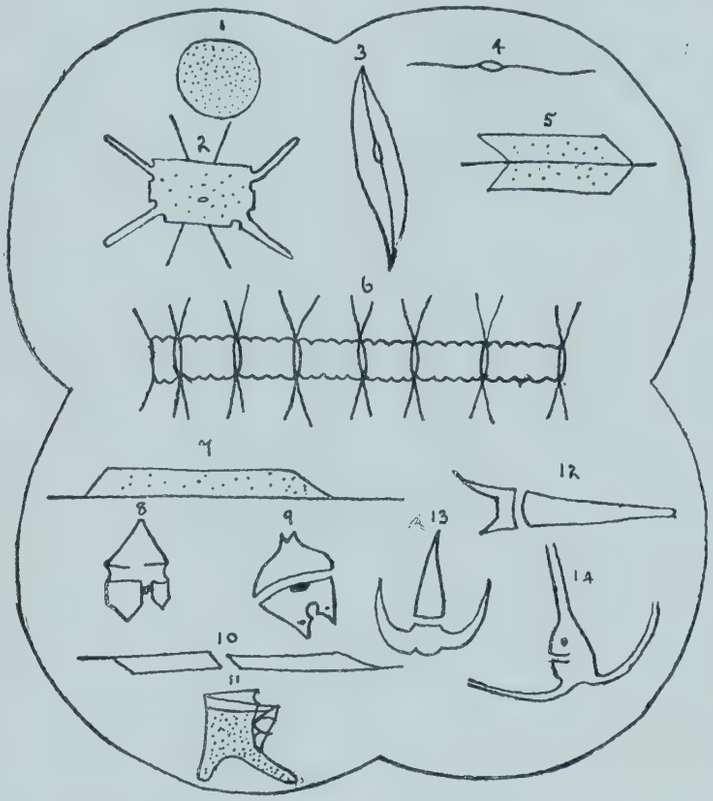


Dissection
showing the alimentary System

iv

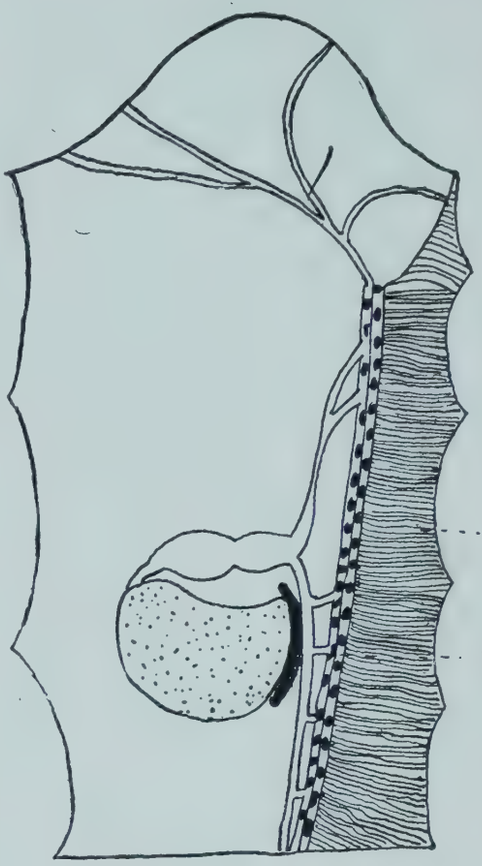
ANATOMY OF *Ostrea madrasensis*

1. Coscinodiscus
2. Biddulphia (granulata)
3. Navicula
4. Rhizosolenia
5. Biddulphia
6. Chaetoceras (crinitum)
7. Rhizosolenia
8. Peridinium
9. Peridinium
10. Rhizosolenia
11. Pinophysis (miles)
12. Ceratium (lineatum)
13. Ceratium (tripos)
14. Ceratium (bischoceras)



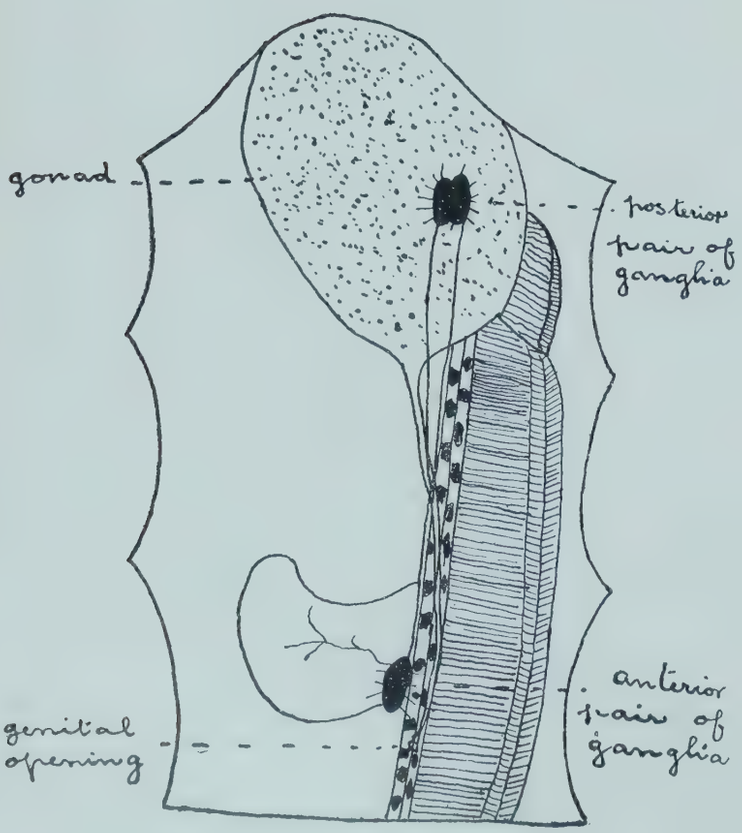
Stomach-contents

V



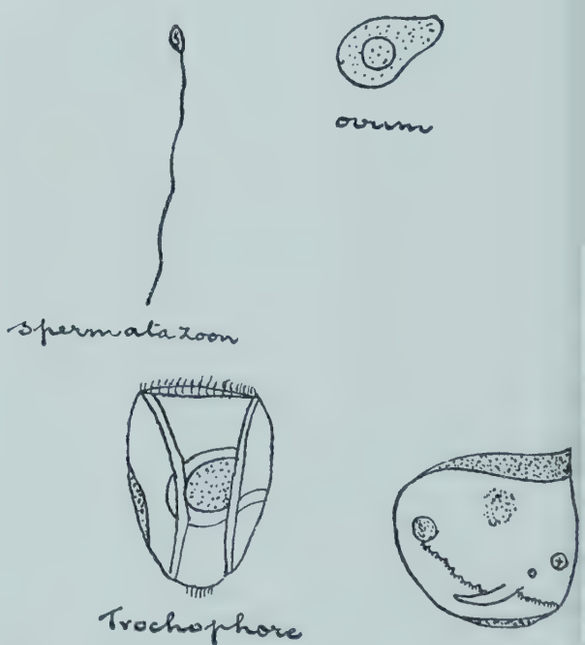
Dissection showing the Vascular & Renal system

VI



Dissection showing the Genital & Nervous systems

VII



VIII

They are plaited and consist of a multitude of filaments closely covered with cilia. These cilia by their concerted action set the currents going; the stream of water aerates the blood as well as supplies food. The cilia also strain the food particles. The gills do not serve as a broodpouch unlike in the freshwater mussel though it does in another species *O. edulis* of Europe.

Muscular system.—The only muscle present in the adult is the posterior adductor, roughly rectangular with the dorsal side concave and stretching transversely across the body from valve to valve. The anterior of the two muscles present in the embryo atrophies later. The mantle has a radiating bundle of muscular fibres which withdraw the edge of the mantle from the margin of the shell and a set of fibres distributed lengthwise along the edge, which by contraction make it crinkled. The muscle fibres as in all bivalves are unstriped.

Excretory system.—The renal organs which are rudimentary, consist of a pair of simple tubes lined by secretory cells. One opening is into the pericardium while the other is into the mantle cavity, as in other Pelecypods.

Nervous system.—It is very simple consisting of two pairs of ganglia (aggregations of nerve-cells). The anterior pair have two commisures one on each side uniting them to the posterior pair lying below the muscle. The anterior pair innervate the internal organs while the mantle and muscles receive their nerve supply from the posterior.

The two rows of tentacles fringing the mantle are very sensitive and function as tactile organs. Eyes are absent though their function seems to be attended to by the marginal sense organs which react quickly even to a shadow flitting across the gape. Neither otocysts nor osphradia are seen but oysters do hear and detect changes in the salinity of the water. The veliger possesses an otocyst.

Reproductive system.—The fatness of an oyster lies in the fulness of the gonad which is found enveloping the visceral mass. The sexes are separate. If the milky fluid from the gonad be examined with a hand lens, that with particles present is the male's and the one without is the female's. The gonads are large paired glands and open out by ducts into the mantle cavity above the gills. When well developed they are swollen and enwrap the dark digestive glands—oysters are then very tasty to eat—the least pressure making the cream colored fluid exude. The ova and sperms pass out into the water through the mantle cavity and fertilization is external and accidental. The oyster spawns all the year round though two maximal seasons may be recognized, April to June and September to November. Sexual activity is stimulated usually by a reduction in the salinity and this depends on rainfall and sunshine.

The oyster passes through trochophore and veliger stages in its life-history. The veliger possesses a foot which is functional till the spat settles down to a fixed life. There is also an otocyst.

The growth after fixation is rapid, the oyster attaining a marketable size in 1½ years. The size attained within four months is remarkable but the shell is thin. The thickness and weight of the

shell connote the age of the oyster better than its length and breadth. The largest examined was from the Pulicat Lake and the right valve measured 17″ by 7″.

Among curious places where spat settled down, were the two eyestalks of a thus blinded crab *Scylla serrata* from Pulicat Lake. The unfortunate crab had on its carapace many barnacles and on its gills Lepads identified as *Dichelaspis cor*.

ORNITHOLOGY IN THE BIBLE

BY

THE LATE LT.-COL. C.E. LUARD

Ah, the land of the rustling of wings,

Which is beyond the rivers of Ethiopia.

Before turning to the passages dealing with birds, a brief glance at the geography of the region involved will be useful. The area with which we are concerned is roughly Palestine, that is Cannaan and Syria and the neighbouring lands of Arabia, the Sinai Peninsula and more distant Egypt.

Dean Stanley in his charming *Sinai and Palestine* points out how the Peninsula of Sinai is remarkable for possessing the three grand features of earthly scenery, the sea, the desert and the mountains. The great desert area is, however, cut into by three great clefts, the Nile on the west, the Gulf of Suez in the centre and the Gulf of Akaba on the east, which last merges into the deep valley of the Arabah and yet deeper Jordan valley, further on. Palestine forms a high level tract lying between the plains of Assyria and the Mediterranean. Long before the war made it a reality, it was familiar to all of us of the older generation from very early days, as a land intimately connected with the absorption of tiresome chronological and historical minutiæ concerning an apparently very overrated people. From north to south a great limestone ridge, which splits into two parallel chains, traverses the whole country, while four rivers the Orontes, Litani (or Leontes), the Barada (Abana of the O.T.) and the Jordon flow through it. The last is the most important and is the main artery of Palestine. On either side of it run chains of mountains linking up with those of Sinai. Palestine is thus curiously isolated. On the east is a desert, in the centre the deep Jordon valley, a formidable trench, on the west the sea, on the south desert again and on the north the Lebanon range. So this small area, only some one hundred and forty miles long and sixty wide, offers variations in climate, soil and vegetation which make it an ideal place for animal life of all kinds. While the Jordon valley falls to 2,300 feet below sea-level, the mountains of Lebanon rise to over 2,000 feet above it, with snow-capped peaks. Thus snow-covered hills, deep and fertile valleys, dry hot winds from the deserts and cool sea breezes, offer unusual opportunities for bird life, through the various plant and insect life the area produces.

Palestine lies in the Holarctic region of Newton or Palaearctic of Sclater above the Ethiopian and Indian, and many bird forms common in India are met with, such as bulbuls, the white-breasted kingfisher, sun-birds, and many birds of prey.

The birds Moses encountered were probably much the same as those met with in this region to-day.

The birds mentioned in the Bible are not of course all those seen by the writers but only those which entered most into their daily lives either as beneficent or unkindly visitants, and those which were striking and useful in metaphor.

To the Israelites lying out on the slopes of Mount Hermon or watching their flocks and herds in the fertile plains, the birds of prey were of peculiar interest, and but too familiar and dreaded visitors. How often must the youthful David have watched

" the eagle that swoopeth on the prey."

We may, therefore, take the birds of prey together as a conspicuous group. This is the more useful in that it is not always easy to say if an eagle, kite or vulture is referred to. But is this surprising ? Take any five of your friends out and see how many birds they can distinguish even when not so closely connected as the birds of prey or so similar in habits and appearance, that save in their size and idiosyncracies of flight they offer no very distinctive signs.

I would here note that throughout this account the Revised Version (R.V.) is referred to unless the Authorized Version (A.V.) is especially noted.

The birds of prey mentioned are, eagles, the glede, falcons, gier-eagle, the kite, hawk, osprey, ossifrage and vulture. The owls may be dealt with separately.

The A.V. and the R.V. differ in the translation of the principal passage which mentions these birds. I may add that throughout this article I have quoted somewhat fully as many members of the Society may be unfamiliar with our Bible, while my own experience has proved how seldom my countrymen's houses contain a copy of the Revised Version.

The two passages lie in Leviticus and Deuteronomy and enumerate birds which were unclean and therefore not fit for food.

R. V.

Lev. 11-13, 17 :

> And these ye shall have in abomination among fowls ; they shall not be eaten, they are an abomination ; the eagle, and the gier-eagle, and the osprey ; and the kite, and the faclon after its kind ; every raven after its kind and the ostrich, and the night-hawk, and the sea-mew, and the hawk after its kind ; and the little owl, and the cormorant, and the great owl ; and the horned owl, and the pelican, and the vulture ; and the stork, the heron after its kind, and the hoopoe and the bat

A.V. (*as given*)

> Eagle, and the ossifrage, and the osprey and the vulture, and the kite after his kind ; every raven after his kind ; and the owl, and the night-hawk, and the cuckow, and the hawk after his kind, and the little owl, and the cormorant, and the great owl, and the swan, and the pelican, and the gier-eagle, and the stork, the heron after her kind, and the lapwing and the bat.

The changes are those of gier-eagle for ossifrage, kite for vulture, falcon for kite, ostrich for owl, sea-mew for cuckow, horned owl for swan, vulture for gier-eagle and hoopoe for lapwing. The bat seems to have been looked upon as a bird.

In the corresponding passage in Deuteronomy (14-11) the lists run thus :

R.V.

Eagle, gier-eagle, osprey, glede, falcon, kite, raven, ostrich, night-hawk, little owl, great owl, horned owl, pelican, vulture, cormorant, stork, heron and hoopoe.

A.V.

Eagle, ossifrage, osprey, glede, kite, vulture, raven, owl, night-hawk, cuckow, hawk, little owl, great owl, swan, pelican, gier-eagle, cormorant, stork, heron and lapwing.

It should be borne in mind that the Hebrew word is of course the same in the A.V. and R.V., only the interpretation is new.

Birds of Prey

In his solitude and grief, and, be it added, the lecturing of his prosy but well-meaning friends, Job seems to have turned instinctively to nature.
Job 12-1 :

No doubt ye are the people,
And wisdom shall die with you.
I have understanding as well as you
. . . . . .
7. But ask now the beasts, and they shall teach thee ;
And the fowls of the air, and they shall teach thee ;
Or speak to the earth, and it shall teach thee.

Some of the finest passages on birds are his. In chapters 36 and 37 Elihu pours out his long-winded discourse naively commencing with

Suffer me a little and I will shew thee
For I have yet somewhat to say on God's behalf.

Until God, losing patience, speaks from the storm which has gathered as Elihu discoursed, and exclaims,

Who is he that darkeneth counsel by words without knowledge ?

and then asks Job who he is and of what account :
39-27 :

Doth the hawk soar by thy wisdom,
And stretch her wings toward the south ?
Doth the eagle mount up at thy command ?
And make her nest on high ?
She dwelleth on the rock, and hath her lodging there,
Upon the crag of the rock and the stronghold.
From thence she spieth out the prey :
Her eyes behold it afar off.
Her young ones also suck up blood :
And where the slain is, there is she.

Possibly here some confusion has arisen with kites or vultures but many eagles do eat carrion, at times. I have myself seen the Indian tawny eagle (*Aquila vindhiana*) sharing a dead cow with kites, vultures and dogs.

The passage is an astonishing summary of eagle life. The strength, swiftness and savage nature of these birds are constantly used in metaphor:

Job 9-25:

> Now my days are swifter than a post:
> They flee away, they see no good
> They are passed away as the swift ships:
> As the eagle that swoopeth on the prey.

The post is the 'harkara' of India, each man doing his section of a journey:

Jer. 51-31:

> One post shall run to meet another.

Solomon used the eagle in metaphor:

Prov. 30-18:

> There be three things which are too wonderful for me,
> Yea, four which I know not:
> The way of an eagle in the air,
> The way of a serpent on a rock,
> The way of a ship in the midst of the sea,
> And the way of a man with a maid.

Then there is that fine passage in Jeremiah, in chapter 4, where in verse 13 the swiftness of the eagle is referred to; it is dramatic in form and for proper appreciation the speakers should be indicated:

Jer. 4-11:

10. *Prophet.*

> Ah, Lord God! Surely thou hast greatly deceived this people and Jerusalem, saying, 'Ye shall have peace'; whereas the sword reacheth unto the soul. And at that time shall it be said to this people and to Jerusalem.

A Cry:

> A hot wind from the bare heights in the wilderness toward the daughter of my people, not to fan, nor to cleanse.

The Lord:

> A full wind from these shall come for me: now will I also utter judgments against them. Behold, he shall come up as clouds and his chariots shall be as the whirlwind; his horses swifter than eagles.

The People:

> Woe unto us for we are spoiled:

Here whirlwind, horse and swooping eagle are brought together as the swiftest things the writer knew.

In Habbakuk, which is really written throughout in dramatic form, though this is not brought out in our Bible, he refers to the approaching Chaldean attack. The Prophet cries to the Lord in verses 1–4 and in verses 5–10; the Lord replies:

V. 6. *The Lord:*

> For, lo, I raise up the Chaldeans that bitter and hasty nation, which march through the breadth of the earth to possess dwelling places which are not theirs. They are terrible and dreadful: their judgment and their dignity proceed from themselves. Their horses also are swifter than leopards, and are more fierce than evening wolves; and their horsemen spread themselves: yea their horsemen come from far; they fly as an eagle that hasteth to devour.

In some passages confusion between vultures and eagles can be clearly detected. Thus :
Micah. 8-16 :

> Make thee bald, and poll thee for the children of thy delight,
> Enlarge thy baldness as the eagle :
> For they are gone into captivity from thee.

No eagles are bald, whereas vultures often are. Probably the well-known passage in Matthew is another instance :
24-28 :

> Wheresoever the carcase is there will the eagles be gathered together.

In both cases the marginal reading is ' vultures.'

In the wonderful song sung by Moses in the 32nd chapter of Deuteronomy the eagle is used in metaphor :
Deut. 32-10, 11 :

> He found him in a desert land,
> And in the waste howling wilderness ;
> He compassed him about, he cared for him,
> He kept him as the apple of his eye :
> As an eagle that stirreth up her nest,
> That fluttereth over her young,
> He spread abroad his wings, he took them,
> He bare them on his pinions :

The A.V. has for the last line :

> taketh them, beareth them on his wings

apparently with the idea that an eagle carried its young in this way.

In that most wonderful of laments (quoted at the end of this article) David compares Saul and Jonathan to eagles (II Sam. 8-17).

Like Moses, Isaiah uses eagles in referring to God's care for Israel : and the freeing of God's servants :
Is. 40-28 :

> . . . the everlasting God, the Lord, the Creator of the ends of the earth, fainteth not neither is weary. . . . But they that wait upon the Lord shall renew their strength : they shall mount up with wings as eagles : they shall run and not be weary, they shall walk and not faint.

There are many other passages, which will be found in the index of references, but these are perhaps the most important.

Vultures are specifically referred to in certain passages, besides the marginal alternative readings mentioned.

The vulture is one of the unclean birds, but the R.V. has gier-eagle where the A.V. has vulture, and a marginal reading ' great vulture ' against ' eagle '. In the corresponding passage in Deuteronomy the R.V. has ' gier-eagle ' where the A.V. has ' ossifrage '.

The vulture was of course as familiar an object to the Israelite as it is to us in India.

The vulture occurs in no passages except in these lists, in the R. V. as in the two passages in the A. V. viz., Job 28-7 and Is. 34-15 we now have ' bird of prey ' in the first and ' kite ' in the second.

Without going into the question too closely it will be interesting to consider the basis on which these translations are founded.

Generally the R.V. has accepted the premise that resemblance between the modern Arabic name and the early Hebrew word is a sure guide to identification of the bird.

The Hebrew word translated 'eagle' is 'nesher' from a root meaning 'to tear with the beak'. This corresponds with the Arabic word 'nasr' (نسر) with an identical meaning which though also used as a generic term, with qualifying adjectives for eagles, vultures, and ospreys, is usually applied to the Gryphon vultures (*Gyps fulvus*) and this is no doubt the bird meant. The passage in Mich. 1–16 where the word 'nesher' is used also shews this while the passages in Job 39-27, 30, Jer. 49-16 describe it well. The Assyrian vulture god, Nisroch, morever, was the Gryphon vulture, the marginal reading actually giving 'great vulture'. The Hebrew word 'rāchām' (Lev. 11-18; Deut. 14-17) is the same as the Arabic 'rakham' and 'rakhma' (رخمة) which the R.V. translates 'vulture' in place of the 'gier-eagle' of the A.V. The Arabic word designates the White Scavenger Vulture (*Neophron percnopterus*) a near relative of the 'Pharaoh's chicken' of our cantonments. The word 'vulture' is a translation of three Hebrew terms in the A. V., 'da-āh' (Lev. 11-14) and 'dayyah' or 'dayyoth' (Deut. 14-13; Is. 34-15). But in the R. V. it is rendered 'kite' in these places. The third term is 'ayyah' (Lev. 11-14; Deut. 14-13; Job 28-7) which the R. V. renders 'falcon'. The latter certainly means a small bird of prey and hence falcon is better 'hidayah' in Arabic is used of a kite. Possibly the 'daah' was the Red Kite (*Milvus regalis*) and 'ayyah' the black (*M. ater*).

The Gier-eagle or Ossifrage translates 'peres' (Lev. 11-13; Deut. 14-12) or 'the breaker'. The Lammageier or Bearded Vulture (*Gypætus barbatus*) was said to throw tortoises, etc., down from a height to break them, hence its name of 'bone-breaker'. The 'glede' (Deut. 14-13) may be a kite or hawk. The word is according to the *New Oxford Dictionary* used locally for buzzards, the osprey, and the peregrine, but more properly for the kite (*M. regalis*). The word is derived from a root meaning to 'glide'. The Hebrew word so translated is 'raah'.

The word 'hawk' translates the Hebrew 'nes' (Gen. 40-10; Lev. 11-16; Deut. 14-15; Job 39-26) and probably refers to the Kestrils, of which *T. chenchris* is commonest: but it may refer to the sparrow-hawk. But the term is generic for the smaller kinds of bird of prey. Some eighteen species of hawk have been recorded from Palestine.

A few passages deal with these birds:

Job 39-26:

> Doth the hawk soar by thy wisdom?
> And stretch her wings toward the south?

Is. 34-15:

> There shall the kites be gathered, every one with her mate.

It is thus clear that it is no easy matter to distinguish the different species from the words used.

In the New Testament in Matthew 24-28 and Luke 17-37 the word translated eagle is 'ætos' (αετος), though vultures are certainly meant. In Revelations 4-7, 12-14 eagles may be intended.

Falcons besides being in the lists of the unclean are mentioned in Job 28-7 where the A.V. has vulture. This last passage is very obscure in the A. V., whereas the R.V. clearly shows that a mine is being described, and well described :

Job 28, 1-11 :

> Surely there is a mine for silver,
> And a place for gold which they refine.
> Iron is taken out of the earth,
> And brass is molten out of the stone.
> Man setteth an end to darkness,
> And searcheth out to the furthest bound
> The stones of thick darkness and of the shadow of death.
> He breaketh open a shaft away from where men sojourn ;
> They are forgotten of the foot that passeth by ;
> They hang afar from men, they swing to and fro.
> As for the earth out of it cometh bread ;
> And underneath it is turned up as it were by fire.
> The stones thereof are the place of sapphires,
> And it hath dust of gold.
> That path no bird of prey knoweth,
> Neither hath the falcon's eye seen it :
> The proud beasts have not trodden it,
> Nor hath the fierce lion passed thereby.
> He putteth forth his hand upon the flinty rock ;
> His eye seeth every precious thing.
> He bindeth the streams that they trickle not ;
> And the thing that is hid bringeth he forth to light.

One is apt to regret that the keen-sighted 'vulture,' as in the A.V., was not retained where we now have falcon.

Game Birds.—The only game birds mentioned are the partridge and the quail. It is curious that ducks are nowhere mentioned, although they must have been common enough even if they did not enter much into the life of the Jewish shepherd, and were perhaps not eaten. It has been suggested that the "fatted fowl," of I Kings 4-23, may be a duck or a goose, as the latter were fattened by the Egyptians.

Partridge is a translation of the Hebrew word 'qōrē,' which occurs twice only, in I Sam. 26-20, Jer. 17-11. The Hebrew name is onomatopæic from the bird's call.

The 'partridge of the mountains'

(I Sam. 26-20) is probably *Ammoperdix heyi* which is very common near the Dead Sea. It should, however, be noted that the Septuagint has, 'is come out to seek my life' where our Bible has 'a flea'. When hunted this bird conceals itself easily owing to its protective colouring. The other partridge met with is the Red-legged Chukor (*Caccabis chukor*) well known in India. Its cry is heard everywhere. The Arabic name for this bird is 'karia' (قارية).

The sandgrouse has been also suggested. In Eccus. 11-30 it is mentioned as being used as a decoy ; or possibly for fighting :

> Like as a partridge taken and kept in a cage so is the heart of the proud.

Partridges are still used as decoys to catch Chukor.

The passage in Jeremiah has caused much comment : Jer. 17-11 :

As the partridge that gathereth young which she hath not brought forth, so is he that getteth riches, and not by right ; in the midst of his days they shall leave him, and at his end he shall be a fool.

The words are spoken in a series of remarks not unlike proverbs. The passage may be corrupt as there is nothing known of this bird to lead one to suppose that partridge broods get mixed up.

Quail are first mentioned in Exodus 16-13 :

And it came to pass at even that the quails came up, and covered the camp : and in the morning the dew lay round about the camp.

Num. 13- 31 :

And there went forth a wind from the Lord, and brought quails from the sea, and let them fall by the camp, about a day's journey on this side, and a day's journey on the other side, round about the camp, and about two cubits above the face of the earth. And the people rose up all that day, and all the night and all the next day, and gathered the quails.

The same event is alluded to in Psalms 78-25 and 105-39 :

The birds were migrating and driven by the high wind to rest after crossing the sea. They come in March ordinarily in vast quantities. The Hebrew for quail (*Coturnix communis*) is ' selav ' connected with a root meaning ' to be plump '. The Arabic word is similar, ' salwa ' (سلوى). Sandgrouse have been suggested here also but so strong a flier would scarcely become exhausted in this way.

We may now pass on to birds of other classes. The words translated ' bird ' are in the Old Testament four in number (i) ' *oph*,' rendered by bird or fowl, the latter generally described as ' of heaven ' or ' of the air ' (Gen. 1-21, 30 ; Lev. 1-14 ; Job 12-7 ; Ps. 50-11 ; etc.) ;

(ii) ' *ayit* ', rendered ' fowls ' or ' birds of prey ' in the A. V. and R.V. respectively (Gen. 15-11, 13 ; Job. 28-7 ; Is. 46-11 ; Ez. 39-4 ; etc.) ;

(iii) ' *tsippor* ', Arabic ' asfūr ' : (اصفور) is used of all small twittering birds (Gen. 7-14 ; Lev. 14-4 ; Ps. 102-8 ; etc.) ;

(iv) ' *baal kanaph* ' or ' possessor of a wing ' (Pro. 1-17 ; Is. 10-14 ; etc.).

In the New Testament two words are used ' ta petaina ' (*τά πετεινα*) see Mt. 13-4 ; Lk. 13-19 ; and ornea (*ορνεα*) for ' birds of prey ' (Rev. 18-2 ; 19-17, 21).

Birds were not unsympathetically noted as we find their salient habits recorded. Migration is referred to, thus Isaiah evidently takes this metaphor from large migrating flocks, when he says : *Is.* 31-15 :

As birds flying so will the Lord of hosts protect Jerusalem.

Jer. 8-7 :

Yea, the stork in the heaven knoweth her appointed times, and the turtle and the swallow and the crane observe the time of their coming ; but my people know not the ordinance of the Lord (*cf.* Cant. 2-12.)

Care of their young (Deut. 32-11 ; Mic. 23-37 ; etc.) their helplessness (Ps. 104-12). They were also tamed (James 3-7). Birds were used as food when clean and not in the prohibited list, quail, partridge, pigeons and doves are mentioned as eaten, while the Talmud gives a good deal of information on keeping birds for this purpose. The very poor eat sparrows (Mt. 10-29), while the eggs of clean birds were also used as food (Deut. 22-6; Is. 10-14 ; Lk. 11-12) The verse in Job is doubtful :

Job 6-6 :

> Can that which hath no savour be eaten without salt ?
> Or is there any taste in the white of an egg ?

The marginal reading ' purslain ' for the white of an egg is apparently correct and not as in the text.

Bittern.—This is one of those cases, not many, in which the Revisers seem to have gone astray. Where the A.V. has bittern the R. V. has porcupine. As will be seen below it endows the porcupine with vocal powers and an agility it certainly never possessed.

Is. 14-23 :

> For I will also make it (Babylon) a possession for the bittern and pools of water : and I will sweep it with the bosom of destruction.

A.V.

Zeph. 2-13 :

> And the flocks shall lie down in the midst of her (Nineveh), all the beasts of the nations both the cormorant and the bittern shall lodge in the upper lintels of it ; their voice shall sing in the windows. . . .

Is. 34-11 :

> But the cormorant and the bittern shall possess it ; the owl and the raven shall dwell in it. . . .

Whereas bitterns with their mysterious ' booming ' call, cormorants, ravens, and even the pelican, who takes the cormorant's place in the R.V., are suited to ruined places and pools of water and some of them can also perch, no porcupine ever climbed on to a ' chapiter ', as the R.V. has it, or sang in a window ! The Revisers took the Hebrew word ' quippod ' as porcupine owing to its resemblance to the Arabic ' kunfud ' (قنفد).

Cocks and hens.—Domestic fowls came into use, it appears, about 4 B.C. since all earlier representations are of wild fowl, as the drooping tail shows. The Old Testament nowhere mentions them but we meet with them in the New Testament (Lk. 13-34). The crowing of the cock is dramatically used in the well-known scene with Peter (Mt. 14-30) : this cock-crow was the third watch just before dawn.

Cormorant and Pelican.—The word ' qāath ' in Hebrew is translated cormorant in the A.V. but Pelican in the R.V. so that the cormorant in the R. V. is only mentioned in the lists of prohibited birds. The root of the Hebrew word means ' to vomit ' (Zeph. 2-14 ; Is. 22-11 ; 102-6). Actually the Pelican is not ' of the wilderness ' in the sense of desert as it is a water haunting bird.

Two species are common *P. onocrotalus* and *P. crispus*, the latter having curled feathers on its head.

The word translated cormorant in the R.V. is 'shālākh' that is a 'diver' (Lev. 11-17; Deut. 14-17). Its harsh cry is well known. There are two species *Phalacrocorax carbo* and *P. pygmæus*.

Crane and Swallow.—Translation has associated these very different birds, and the swift. The word 'sūs' or 'sīs'(Is. 38-14; Jer. 8-6; Zac. 10-3; Ps. 32-9) is in the A. V. rendered by crane but in the R.V. by swallow. It should actually be swift. In the same passages the A.V. translates 'agūr' swallow and the R.V. crane.
Is. 38-14:

> Like a swallow or a crane so did I chatter,
> I did mourn as a dove.

Jer. 8-7.

> . . . and the swallow and the crane observe the time of their coming.

In Psalm 84-3; 26-2: it is the word 'derōr' that is translated rightly swallow: 84-3:

> Yea, the sparrow hath found her an house,
> And the swallow a nest for herself, where she may lay her young,
> Even thine altars, O Lord of hosts, my King and my God.

These references are generally appropriate except that the term chatter is not very clear as though swallows might perhaps be said to chatter, cranes utter a more sonorous and trumpet-like note.

Cranes (*Grus communis*) are met with in winter in enormous numbers. Dean Stanley recounts how near Wadi Haderah the sky was literally darkened by a vast flight of red-legged cranes, with black and white wings. In the case of swifts and swallows in India one is familiar with their hordes building in temples and mosques.

Crow.—Not perhaps really distinguished from the raven. But it is only mentioned in the Apocrypha, in Baruch 6-54.

Cuckow and Sea-mew.—The Cuckoo (Lev. 11-16: Deut. 14-15) has vanished from the R.V. giving place to the Sea-mew. The Hebrew word is 'shahaph.' It was a water bird and may have been a gull. It is rightly placed in the list of the unclean which a cuckoo would not be.

Dove and Turtle-dove.—Words used in the Hebrew are three, and are not clearly distinguished as between doves and pigeons, which is not surprising seeing that modern ornithology cannot successfully differentiate between the two. The three words used in Hebrew for these birds are:—(i) '*yonah*' (Lev. 5-7) which come from a root meaning to mourn and refers more to pigeons; (ii) '*tor*' meaning a turtle-dove (Lev. 12-6; Can. 2-12), an onomatopæic word representing its cry, and (iii) '*gozal*' really the young of any bird, a 'cheeper' (Deut. 22-11) but also used for young pigeon (Gen. 15-9).

The first mention of the dove is in the story of the Flood (Gen. 8-8). Doves were evidently domesticated in early days. They were used for sacrifice as were also young pigeons (Gen.15-9). The brilliance of its colouring (Ps. 68-13), its harmlessness (Mt. 10-16), its helplessness (Ps. 74-19) are all referred to. It was used

as a common name and as a term of affection (Cant. 1-15 ; 4-1 ; 5-2 ; 12 ; 6-9). It is also used as a type of the Holy Spirit (Mt. 3-16).

Dean Stanley describes how at Askalon the doves formerly sacred to Venus still inhabited the haunts of their ancestors, though the temple with its rites had long passed away. In a siege the dung of doves was eaten (I K 6-25).

Blue rock pigeons are met with in large flocks in the 'wadis' or gorges : read pigeons for doves below :
Is. 60-8 :

> Who are these that fly as a cloud,
> And as the doves to their windows.

In Ps. 55-6 it should read (yonah) pigeons :

> And I said, Oh had I wings like a dove
> Then would I fly away and be at rest.
> Lo, then would I wander far off,
> I would lodge in the wilderness.
> I would haste me to a shelter
> From the storm, wind and tempest.

The arrival of these birds is referred to also (Jer. 8-7 ; Can. 2-11, 12).

One of the turtle doves (*T. communis*) comes in April, another (*T. senegalensis*) roams the streets of towns half tame.

Fowl.—The word 'ayyit' is translated 'fowl' in the A.V. in certain places in which the R.V. has 'birds of prey' (Gen. 15-11 ; Job 28-7 ; Ez. 39-17—birds) elsewhere fowl is retained.

Hoopoe and Lapwing.—The Lapwing of the A.V. has become Hoopoe (*Upupa epops*) in the R.V. The Hebrew word is 'dukipath' (Lev. 11-19 ; Deut. 14-18). It is only mentioned among the unclean birds. The Hoopoe is a common spring visitor.

Heron.—This bird is only in the prohibited list (Lev. 9-19 ; Deut. 14-18). The R.V. has 'ibis' as a marginal reading. Herons are abundant (*A. cinerea* and *A. purpurea*). The ibis consorts with herons.

Hunting.—It will not be out of place to make some reference to hunting. Hunting for sport is a product of comparatively advanced civilization. Man could not afford to hunt for sport so long as his food supply had to be obtained in the chase. Nimrod was not a hunter for sport, but a mighty slayer of noxious wild animals.

The hunter is noted as uncouth (Gen. 10-9) but cunning. Birds were hunted (Sam. 26-20) as the partridge, and according to the law they had to be bled, similarly to the 'halal' of the Musalman :
Lev. 17-13 :

> And whatsoever man there be of the house of Israel, or of the strangers that sojourn among them, which taketh in hunting any beast or fowl that may be eaten ; he shall pour out the blood thereof, and cover it with dust. (See Deut. 12-16).

Bows and arrows were used (Gen. 27-3 ; etc.) and these were at times of bronze or bronze mounted (Ps. 18-34 ; Job 20-24) the arrows were tipped with flints or iron. Slings were in common use, the tribe of Benjamin excelling in their use (Jud. 20-16 ; 1 Chr. 12-2).

Nets (*resbeth*—Prov. 1-17; Hos. 5-1) and snares or nooses (*moquesh*—Amos 3-5) are mentioned and clubs (Jer. 41-39).
Amos 3-5 :

> Can a bird fall in a snare upon the earth, where no gin is set for him ?

Ps. 69-20 :

> Let their table before them become a snare ;
> And when they are in peace, let it become a trap.

Job 18-9 :

> A gin shall take him by the heel,
> And a snare shall lay hold on him.

The A.V. has ' robber ' for snare.

The noose was used as also traps (Job 18-10). The fowler used such devices (Hos. 9-8). The word ' cage ' in Jer. 5-27 should be ' trap '. Pits were used (Ez. 19-8). Decoys are mentioned (Eccus. 11-30).

Nests.—Many reference are made to nests, and a warning is given as to letting the parent birds go free (Deut. 22-6). Job refers to his house as his nest (Job 29-18). The Hebrew words is ' qen ' (Gen. 6-14; Deut. 32-11 ; Nu. 24-21 ; Jer. 14-16 ; Hab. 2-9 ; Job 39-27).

Night-hawk.—The word rendered night-hawk is in Hebrew ' tēchmās ' which merely means a bird of prey being connected with a root ' to tear '. The night jar is in no sense a bird of prey and identification is, therefore, uncertain. The Septuagint and Vulgate translate it by owl (Lev. 11-16 ; Deut. 14-15).

Osprey.—The Osprey is only given in the prohibited lists in Leviticus and Deuteronomy, and is a translation of the Hebrew ' ozniyyāh '. It is unlikely to have been the osprey as there were no hunting grounds for it and probably it is another eagle or a harrier. The word osprey (Fr. *osfraie*) is itself merely a corruption of ossifraga, the name of the lammageier.

Ossifrage.—See birds of prey above.

Ostrich.—In the A.V. the Hebrew words ' bath yaanāh ' (Lev. 11-16 ; Deut. 14-15 ; Job 30-29 ; Is. 13-21 ; 34-13 ; 43-20 ; Jer. 50-39 ; Mic. 1-8) are translated ' owl '. But the word means ' daughter of greed '. Two other words ' yeēnīm ' (Lam. 4-3) and ' reanim ' (Job 39-13) are translated owl and peacock in the A.V., but should be ostrich (*Struthio camelus*) which is met with in Barbary, Syria, Arabia and even Mesopotamia, while formerly it inhabited Egypt.

The ostrich has a very weird cry not, it is said, unlike a loud groan.
Mic. 1-8 :

> For this I will wail and howl ;
> I will go stripped and naked :
> I will make a wailing like the jackals,
> And a mourning like the ostriches.

Its preference for lonely spots is noted :
Job 30-29 :

> I am a brother to jackals
> And a companion to ostriches

Then Isaiah in describing the destruction of Edom cries : *Is.* 34-13 :

> And thorns shall come up in her places, nettles and thistles in the fortresses thereof ; and it shall be an habitation of jackals, a court for ostriches.

In that great lecture on natural history which comes in the 29th Chapter of Job there is a dissertation on the ostrich : *Job* 39-13 :

> The wing of the ostrich rejoiceth ;
> But are her pinions and feather kindly ?
> For she leaveth her eggs on the earth,
> And warmeth them in the dust,
> And forgetteth that the foot may crush them,
> Or that the wild beast may trample them.
> She is hardened against her young ones, as if they were not hers,
> Though her labour be in vain, she is without fear ;
> Because God hath deprived her of wisdom.
> Neither hath he imparted to her understanding.
> What time she lifteth up herself on high,
> She scorneth the horse and his rider.

The ostrich is too curious an instance of bird life not to attract attention, for a bird eight feet high which defends itself by kicking like a horse, has long eyelashes, only two toes and no wings to speak of, except ornamental plumes is an anomaly. The ostrich is polygamous, one cock having three or four hens. They lay in a common nest, a shallow pit scraped by their feet in the sand, which is heaped upon the sides as a protective wall. The cock begins the brooding as soon as a dozen eggs or so are laid, especially at night, by day their attendance is for watch and ward rather than hatching which is done by the sun's rays. The recognition of individual offspring by the mothers was thus not possible.

Owls.—The correction of owl to ostrich is given above. The words rendered owl are ' yansüph ' (Lev. 11-17 ; Deut. 14-16 ; Is. 34-11), the ' great owl ' but the Septuagint reads ibis : ' kos ' (ib. and Ps. 102-6) little ' owl ' and owl ; ' tinshemeth ' (Lev. 11-18 ; Deut. 14-16 ; Is. 34-11) is translated ' horned owl ' in the R.V. but swan in the A.V. ' qippoz ' (Is. 34-15) ' great owl ' in A.V. and ' arrow-snake ' in R.V. but as obviously a bird is meant the R.V. seems in error here ; ' lilith ' (Is. 34-14) in A.V. ' screech-owl ' becomes ' nightmonster ' in R.V. as in margin of A.V. Lilith is a fabulous monster, hairy and very fond of attacking infants, often appearing in female shape. Owls are very common in Palestine. *Athene glaux*, the ' bomeh ', is very tame and a great favourite, *Otus ascalaphus*, etc.

Peacocks.—Mentioned in I. K. 10-22, 2 Chr. 9-21.

> Once every year came the navy of Tarshish bringing gold and silver, ivory and apes and peacocks.

The word is ' tūkkīyyim ' and as the bird was not indigenous but imported the name is considered to be a corruption of the Tamil word for this bird, ' tokei '. The passage in Job 39-13 has ostrich in R.V. for the peacock of A.V., the Hebrew word being ' renānīm '.

Pelican.—See Cormorant.

Porcupine.—See Bittern.

Raven.—It was an unclean bird (Lev. 11-15; Deut. 14-14) and no doubt is not always distinguished from crows in the Bible. They are common in Palestine. The Hebrew word 'oreb' (Ar. Ghuráb) comes from a root meaning 'to be black', and hence includes all corvidae.

Sea-mew.—See Cuckow.

Speckled bird of prey.—This occurs in Jer. 12-9. The passage is :

> Is mine heritage unto me as a speckled bird of prey?
> Are the birds of prey against her round about?

It is not very clear what is meant except that birds of prey are inimical.

Stork.—The stork is among the unclean birds, but the crane is not (Lev. 11-19; Deut. 14-18, Job 39-13; Ps. 104-17; Jer. 8-7; Zac. 5-9). The Hebrew word is 'chasidah' meaning 'loving kindness. It is a useful bird in clearing caterpillars and locusts off the field', and is much prized in consequence, and nicknamed by the Arabs 'Am Said' or the 'Father of good luck'. It was hence sacred and is perhaps, therefore, mentioned to preserve it. The white stork (*Cicona alba*) is the commonest though the black variety (*C. nigra*) occurs.

Sparrow.—The word translated sparrow is 'tsippor' (Ps. 84-3; 102-7—fowl in A. V.) which means only a small twittering bird (Ar. asfūr (عصفور)). Small birds are not really distinguished and it is not possible to say what bird is actually intended. The 'sparrow on the house top' (Ps. 102-7) is possibly the *Petrocossyphus cyanea*, which is very common, its monotonous note being heard everywhere.

Swallow.—The Hebrew word 'deror' is rightly translated swallow. See Crane. Many varieties are met with, *H. rustica*, *C. urbica*, *Cotyle rupestris*, etc. Bee-eaters are possibly indicated by the same word.

Swan.—This bird has vanished from the R.V. in Lev. 11-18 and Deut. 14-16, and becomes 'horned owl' ('tinshemeth'). But probably the Ibis is meant or a coot; the vulgate has 'porphyrio'.

Before we leave the birds I would draw the attention of readers to the great beauty of many of the passages in which the birds occur. But it is essential, if their real beauty is to be seen, that they should be read in the R. V., or better still in Professor Moulton's 'Modern Readers Bible'.

It is probable that no worse edited book ever issued from a press than our Authorized Version, and it is a remarkable proof of our unquestioning acceptance of the established, that for some three hundred years we made no attempt to improve the form in which the greatest treasure of the English language was placed before us. As has been remarked, if Shakespeare, Bacon, Milton, Hallam, and Tennyson were issued under one cover, no distinction being made between prose and poetry, all titles being excised, the names of all speakers omitted, speeches divided in the middle and sentences cut up into a convenient length for a certain width of column, and the chapters formed of an equal number of obtrusively numbered verses, irrespective of sense or subject, such a work would scarcely be an exaggeration of our Authorized Version. The Revised

Version, much as it leaves to be desired, is a great improvement; especially in the distinction made between prose and verse. But to continue our subject.

These nomad open-air dwelling authors could scarcely have failed to be influenced by the poetry of bird life, and so we find it.

In that wonderful song of Moses in the 32nd Chapter of Deuteronomy which begins:

Give ear, ye heavens, and I will speak;
And let the earth hear the words of my mouth;
My doctrine shall drop as the rain,
My speech shall distil as the dew,
As the small rain upon the tender grass,
And as the showers upon the herb.

and then he continues

V. 9:

For the Lord's portion is his people;
Jacob is the rock of his inheritance;
He found him in a desert land,
And in the waste howling wilderness;
He compassed him about, he cared for him,
He kept him as the apple of his eye;
As the eagle that stirreth up her nest,
That fluttereth over her young,
He spread abroad his wings, he took them,
He bare them on his pinions;

In the Song of Songs, that greatest of epithalamia, bird passages are frequent; but to get the full sense of this dramatic poem the speakers need to be indicated: the Bridegroom, the Bride, the King and the Choruses. In the second phase, in which the Bride is reciting the joys of courtship, we get a lovely spring song.

The Bride:

The voice of my beloved! Behold he cometh
Leaping upon the mountains
Skipping upon the hills.
My beloved is like a roe or a young hart
Behold he standeth behind our wall,
He looketh in at the windows
He sheweth himself through the lattice.
My beloved spake, and said unto me:
'Rise up, my love, my fair one,
And come away.
For, lo, the winter is passed
The rain is over and gone
The flowers appear on the earth
The time of the singing birds is come,
And the voice of the turtle is heard in our land;
The fig tree ripeneth her green figs,
And the vines are in blossom
They give forth their fragrance
Arise, my love, my fair one
And come away.
Oh my dove that art in the clefts of the rock,
In the covert of the steep place,
Let me see thy countenance,
Let me hear thy voice
For sweet is thy voice,
And thy countenance is comely.

One is tempted to quote for ever and it should all be read, but read intelligently.

In the Psalms, bird passages are many. We may take one instance ; *Ps.* 91 :

> For he shall deliver thee from the snare of the fowler,
> And from the noisome pestilence,
> He shall cover thee with his pinions
> And under his wings shalt thou take refuge :

and again in Isaiah, who often uses bird metaphors : *Is.* 18 :

> Ah ! the land of the rustling of wings
> Which is beyond the rivers of Ethiopia ;
> That sendeth ambassadors by the sea,
> Even in vessels of papyrus upon the waters.

In Jeremiah. 4–23–26 ; in describing his vision of the destruction of the earth, he cries :

> I beheld the earth, and, lo, it was waste and void ; and the heavens and they had no light. I beheld the mountains, and, lo, they trembled, and all the hills moved to and fro. I beheld, and, lo, there was no man, and all the birds of the heaven were fled. I beheld, and, lo, the fruitful field was a wilderness, and all the cities thereof were broken down at the presence of the Lord, and before his fierce anger.

One more passage and I must leave it to my readers to search for themselves.

I will end with David's lament for Saul and Jonathan : 1 *Sam.* 31-19 :

> Thy glory, O, Israel.
> Is slain upon thy high places ?
> How are the mighty. . . .
> Fallen !
> Tell it not in Gath,
> Publish it not in the streets of Ashkelon ;
> Lest the daughters of the Philistines rejoice,
> Lest the daughters of the uncircumcized triumph.
> Ye mountains of Gilboa, let there be no dew nor rain upon you,
> Neither fields of offerings :
> For the shield of the mighty was vilely cast away.
> The shield of Saul, as of one not anointed with oils.
> From the blood of the slain
> From the feet of the mighty,
> The bow of Jonathan turned not back,
> And the sword of Saul returned not empty.
> Saul and Jonathan were lovely and pleasant in their lives,
> And in their death they were not divided
> They were swifter than eagles
> They were stronger than lions,
> Ye daughters of Israel :
> Weep over Saul,
> Who clothed you in scarlet delicately
> Who put ornaments of gold upon your apparel
> How are the mighty. . . .
> Fallen in the midst of the battle
> O, Jonathan,
> Slain upon thy high places
> I am distressed for thee, my brother Jonathan
> Very pleasant hast thou been unto me
> Thy love to me was wonderful,
> Passing the love of women.
> How are the mighty. . . .
> Fallen !
> And the weapons of war
> Perished.

So whatever the technical imperfections of the translation we should be thankful to the good fortune that gave us our Bible in the age of Shakespeare and remember the words of Jesus, the son of Sirach :—

> 'Ye are entreated therefore to read with favour and attention, and to pardon us if in any part of what we have laboured to interpret we may seem to have failed in some of the phrases. For things originally spoken in the Hebrew have not the same force in them when they are translated into another tongue.'

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BIRD, *oph* : Gen. 1-21 ; 7-8, 14, etc. ; Lev. 17-13 ; 20-25, etc. ; Ps. 50-11, etc. (in general use).

ayit : Gen. 15-11 ; Is. 18-6 ; Job 28-7 ; Ez. 39-4.

tsippor : Gen. 7-14 ; 15-10 ; Ez. 17-23 ; Ps. 8-8 ; 11-1 (and many other places).

baal kanaph : Gen. 1-21 ; 7-14 ; Ps. 78-27 ; 148-10 ; Job 39-13 (and many other places).

BITTERN (See *Porcupine*) : Is. 14-23 ; 34-11 ; Zep. 2-14. [so in A.V. only.]

CAGE : Jer. 5-27 (better 'trap').

COCKS (N. T. only) : Mt. 26-34, 74, 75 ; Mk. 13-35 ; 14-30, 68, 72 ; Lk. 12-34, 60, 61 ; Job 13-38, 18-27.

CORMORANT, *shalākh* : Lev. 11-17 ; Deut. 14-17 ; Is. 34-11 ; Zep. 2-14 (see Pelican).

CRANE, *agūr* : Is. 38-14 ; Jer. 8-7.

CROW (See *Raven*) : Baruch 6-54.

CUCKOW (See *Sea-mew*).

DOVE AND TURTLE-DOVE, *yōnāh* : *tor* : *gozāl* : Gen. 8-8, 9, 11 ; 10-12 ; 15-9 ; Lev. 1-14 ; 5-7, 11 ; 12-6, 8 ; 14-22, 30 ; 15-14, 29 ; 12-6 ; 14-22 ; Num. 6-10 ; Ps. 55-6 ; 68-13 ; 74-19 ; Cant. 1-15 ; 2-12, 14 ; 4-1 ; 5-2, 12 ; 6-9 ; Is. 38-14 ; 59-11 ; 60-8 ; Ez. 7-16 ; Nah. 2-7 ; Jer. 8-7 ; 48-28 ; Kos. 7-11 ; 11-11 ; Mat. 3-16 ; 10-16 ; 21-12 ; Mark. 1-10 ; Lk. 2-24 ; 3-22 ; In. 1-32 ; 2-14, 16.

EAGLE, *nesher* : Ex, 19-4 ; Lev. 11-13 ; Deut. 14-12 ; 28-49 ; 32-11 ; 2 Sam. 1-23 ; Job, 9-26 ; 39-27 ; Ps. 103-5 ; Prov. 23-5 ; 30-17, 19 ; Is. 40-31 ; Jer. 4-13 ; 48-40 ; 49-16, 22 ; Lam. 4-19 ; Ez. 1-10 ; 10-14 ; 17-3, 7 ; Dan. 4-33 ; 7-4 ; Kos . 8-1 ; Obads 4 ; Mic. 1-16 ; Hab. 1-8 ; Mat. 24-28 ; Lk. 17-37 : Rev. 4-7 ; 12-14.

FALCON, *ayyah* (kite in A.V.) : Lev. 11-14 ; Deut. 14-13 ; Job 28-17 (Vulture in A.V.)

FATTED FOWL (Goose or Duck) : 1. K. 22.

FOWL (See Birds).

FOWLER : Ps. 91-3 ; 124-7 ; Prov. 6-5 ; Jer. 5-26 ; Hos. 9-8.

GIER-EAGLE, *peres* (Ossifrage in A. V.) : Lev. 11-13 ; Deut. 14-12.

GLEDE, *rahah* : Deut. 14-13.

HAWK, Lev. 11-16 ; Deut. 14-15.

HEN : Mt. 23-37 ; Lk. 13-34.

HERON, *anaphah* : Lev. 11-19 ; Deut. 14-18.
HOOPOE (Lapwing in A.V.) : Lev. 11-19 ; Deut. 14-18.
HUNTING (See article) : Lev. 11-19 ; Deut. 14-18 : 1 Sam. 26-20.
IBIS (See Owl).
KITE, *da-ah* : Lev. 11-14 ; *dayyah* : Deut. 14-13.
LAPWING : (A. V.) (See Hoopoe).
NEST : Gen. 6-14 ; Num. 24-21 ; Deut. 22.6 ; 32-11 ; Job 29-18 ; 32-27 ; Ps. 84-3 ; 104-17 ; Prov. 27-8 ; Is. 10-14 ; 16-2; 34-15 ; Jer. 22–25 ; 42-28 ; 49-16 ; Ez. 31-6, 10-9 ; Ob. 4 ; Hab. 2-9 ; Mat. 8-20 ; Lk. 9-58.
NET (See Snares and Hunting).
NIGHT-HAWK, *tachmās :* Lev. 11-16 ; Deut. 14-15.
OSPREY, *ōzniyyah* : Lev. 11-13 ; Deut. 14-12 .
OSSIFRAGE (See Gier-eagle).
OSTRICH, *bathya-anāh* : Lev. 11-16 ; Deut. 14-15 ; Job 30-29 ; Is. 13-21 ; 34-13 ; 43-21 ; Jer. 50-39 ; Micah 1-8; (A.V. has owl.) *ye-enim* ; La. 4-3 ; *reanim* : Job 39-13) A. V. has peacock).
OWL, *kos* : Lev. 11-17 ; Deut. 14-16 ; Ps. 102-6.
quippoz : Is. 34-15. [Great Owl in A.V.] Arrow-snake of R.V. must be a bird.
tinshemeth : Lev. 11-18 ; Deut. 14-16. [Swan in A.V., horned owl in R.V.]
lilith : Is. 34-14 [Screech owl of A.V.], in R.V. is night Tonster.
gansūph : Lev. 11-17 ; Deut. 14-16. In Is. 34-11 is probably the Ibis.
PEACOCK, *tūkkīyyīm :* 1. K. 10-22 ; 2. Chr. 9-21.
PARTRIDGE, *qore* : Is. 26-20 ; Jer. 17-11 ; Sam. 26-20 ; Eccus. 11-30.
PELICAN, *qā-ath* : Lev. 11-18 ; Deut. 14-17 ; Ps. 102-6 ; Is. 34-11 Zep. 2-14.
PORCUPINE, *qippod* (Bittern of A.V.): Is. 14-23 ; 24-11 ; Zep. 2-14.
QUAIL, *selar* : Ex. 16-13 ; Num. 11-31 ; Ps. 106-409.
RAVEN, *oreb* : Gen. 8-7 ; Lev. 11-15 ; Deut. 14-14 ; I K. 17-4, 6 ; Job 38-41 ; Ps. 147-9 ; Prov. 30-17 ; Cant. 5-11 ; Is. 34-11; Lk. 12-24.
SEA-MEW, *shachaph* : Lev. 11-18 ; Deut. 14-15.
SNARES (See Hunting) : Ps. 91-3 ; 124-7 ; Prov. 7–23 ; Eccus. 9-12 ; Hos. 9-8 ; Amos 3-5.
SPARROW, *tsippor* (any twittering bird): Lev. 14-4 ; Ps. 84-3 ; 102-7 ; Mat. 1029 ; Lk. 12-6.
SPECKLED FOWL : Gen. 12-9.
STORK, *chasīdah* : Lev. 11-19 ; Deut. 14-18 ; Job 39-13.
flight of Ps. 104-17 ; Jer. 8-7 ; Zac. 5-8 ; 9.
SWALLOW, *derōr* : Ps. 84-3 ; Prov. 262 : Is. 38-14 ; Jer. 8-7 ; (see Crane).
SWAN, *tinshemeth* (See Owl and Ibis) : Lev. 11-18 ; Deut. 14-16.
TURTLEDOVE, *tor* : Gen. 15-9 , Lev. 1-14 ; 5-7; 11 ; 12-6, 8; 14-22, 30 ; 15-14, 29 ; Num. 6-10 ; Ps. 74-19 ; Cant. 2-12 ; Jer. 8-7 ; Lk. 2-24.
VULTURE, *rāchām* : Lev. 11-18; Deut. 14-17.

REVIEWS

1. 'STALKING BIG GAME WITH A CAMERA IN EQUATORIAL AFRICA with a Monograph on the African Elephant.' By Marius Maxwell. Royal quarto, 200 pp., 113 plates—London: William Heinemann, Ltd. 1925., Price, 52*s*. 6*d*. net.

Mr. Maxwell has done yeoman service in the cause of the Natural History of our larger game animals, and his book is virtually a plea for the protection of wild life from ruthless and wanton destruction and from the complete extermination with which a number of interesting forms are threatened in many parts of the African continent.

The modern camera as a weapon for hunting game is fast gaining in popularity with sportsmen all the world over, and this form of sport is one which certainly deserves all possible encouragement. We hope the day is not far off when it may supersede and completely replace the destructive rifle.

As the author points out, big game photography is an exhilerating sport and provides just as much healthy recreation—and we may add, after a perusal of his experiences, EXCITEMENT—somewhat more than the average sportsman bargains for—as the hunting of game with a rifle. Endless opportunities are at the same time presented to the observer who wishes to study at first hand the peculiarities of the larger creatures of the wilds commonly classed as dangerous. Much useful knowledge may be gleaned by the naturalist regarding the ways and habits of animals from photographs taken in their native surroundings and under perfectly natural conditions, and to the modern artist, sculptor and taxidermist such representations are invaluable for an accurate and truthful portrayal of his subject.

The major part of the book deals in a facile and lucid manner with the African elephant,—his ways, habits, gait, temperament and idiosyncracies. Chapter V on the Senses of the African Elephant is particularly thorough and illuminating and speaks much for the care and attention bestowed by the observer on the behaviour of his subject under varying conditions and circumstances, often extremely trying and uncomfortable. Supported as these observations are by a series of the finest photographs ever obtained of the pachyderm, they supply the most valuable first-hand knowledge we possess of these fast disappearing giants.

Excellent as have been the efforts of previous big game photographers, it is significant that neither Carl Schillings nor Radclyffe Dugmore appear to have been fortunate enough to succeed in photographing the African Elephant, probably on account of the nature of the country the animal frequents. Schillings with his telephoto outfit fully appreciated the difficulties involved, and indeed it is only the modern photographic apparatus equipped with the fastest of lenses that makes success possible in the gloomy ill-lit recesses of the bush country which is their home in daytime. Dugmore, moreover, chiefly employed fairly high power telephoto lenses which are wholly unsuited for instantaneous work in indifferent light. It is interesting to note that Mr. Maxwell advocates ordinary 3·5 to 4·5 (or faster) lenses with a focal length of 6 to 10 inches, such as he himself used, his plan being to stalk up carefully as close to his sitters as possible. He believes that real success with elephants lies only in the use of ordinary lenses at short range, as under the prevailing conditions these give more detailed and faithtul results that can be obtained from even telephoto lenses of low power. Maxwell's views as regards a suitable camera are apparently very different from Dugmore's who fourteen years ago (Camera Adventures in the African Wilds), considered that 'The ordinary little hand camera with its short focus lens is practically useless. Only once in a great while can one approach near enough to use it.' According to Dugmore the sort of camera necessary for the work is one of the long focus reflex type 'equipped with a convertible lens of high speed and a telephoto lens of the greatest speed. The camera must be rigid enough to allow the telephoto lens being used without danger of shaking.'

While acknowledging that both Schilling's and Dugmore's photographs are unique in their own way, and the latter's especially, as a whole, much sharper and better *as photographs*, it must be remembered that Maxwell's object in making his pictures was of a more specific nature. He deplored the

absence of photographic illustrations in the epoch-making works of Selous and Neumann, and set himself out to fill the gap in the photographic records of the larger game animals of Africa by securing a series of photographs illustrating the life and habits of the African elephant in his native haunts, *not* by using such devices as camera-shelters, perches, flashlight or any other artificial means, but by stalking the animals and portraying them exactly as they are seen by the hunter of big game. The measure of his success can be readily gauged by any one who glances over his wonderful array of photographs.

The photographer's intrepidity leaves one agape. His experiences are recorded in a simple matter-of-fact manner and without garnish or exaggeration of the danger involved. In fact, the whole trend of Mr. Maxwell's writings is towards proving that the ferocity and truculence usually ascribed to even such admittedly dangerous creatures as the African buffalo are often much overdone, and that the natural tendency of wild animals is to leave man severely alone. His opinion about the disposition of the African elephant is that as a general rule, when not under severe provocation, he is a patient, retiring and even-tempered beast and by no means as savage as he is usually depicted. He admits however that ' Face to face meetings are at all times nasty incidents and particularly speculative at close quarters.' We like Mr. Maxwell's prescription of how to avoid the fury of a stampeding herd, and the advice is simple enough ; it would appear that the elephant accommodatingly possesses an instinctive aptitude for avoiding obstacles even in a stampede. Well, the thing to do the next time you find a herd bearing down on you is to stand behind the first thorn tree of average size you come across, restrain your natural inclination to bolt, quietly watch the rampaging monsters brushing past with intermittent deafening shrieks and shrill trumpetings, and safety is yours ! Unfortunately, however, ' There are of course exceptions to every rule ' !

One of the most remarkable pictures in the book, plate 5, Chapter III, is of a magnificent Masai bull elephant taken at a distance of approximately eight yards and under conditions that call for special mention. A face to face encounter with the African elephant growing in size at each advancing stride must be one of the finest and most impressive sights in nature, and, as the author says, ' To watch for the first time the reflected image of an advancing elephant with ears extended growing larger and larger on the focussing glass of a reflex camera is perhaps the strangest of possible experiences, and one that is not easily forgotten by the enthusiastic photographer.' This particular bull, on detecting the presence of the cameraman, deliberately moved forward towards him and when some eight yards from the lens suddenly stopped. Life and death hung in the balance. Suspense followed the click of the shutter. An eddy in the wind-currents might have changed the course of events and sent the animal either thundering down on the intruder or crashing through the bush in his haste to get away !

The chapters on Giraffe, Rhinoceros and Hippopotamus are excellent, and supported by a number of wonderful photographs. It is obvious that skilful tactics are required to stalk long-sighted giraffes in the open bush country which forms their usual habitat. The author has been able to secure a unique series depicting the gait of the animal over which there has been some controversy. His *modus operandi* was to pursue the animals in a Ford Car and to photograph them at close range with a short focus lens. Incidentally it is interesting to learn that for a distance of a couple of miles or so when driven to his utmost, a giraffe will keep up a speed of between 28 to 30 miles per hour and that even at this speed they appear to glide along without effort.

The most remarkable achievement with rhino, in our opinion, was when the author obtained four snapshots in succession of a charging rhino in various stages of the assault. The charge commenced at a distance of thirty yards, when the first picture was taken. Three others were subsequently obtained as the animal came on and was turned by a head shot from his companion's rifle, which covered the entire proceedings, and as the animal turned again and again to repeat the attack on its aggressors. Any one who has used a reflex camera will realize what a difficult proposition it is to change films, reset the shutter and make exposures in the face of such an onslaught and in circumstances which cannot but be exceedingly critical and trying.

The only grouse we have against Mr. Maxwell is that he omits to tell us what make of film packs he was using. In view of the excellent results he has obtained we think it was in fairness due to the makers of the film and to other

enthusiastic photographers, whom the book may tempt to follow his lead, to divulge this very important secret of his success.

We cannot too strongly recommend every sportsman and naturalist to possess a copy of this book which will, we confidently believe, stand in a class by itself for many a long day.

S.A.A.

2. POPULAR ZOOLOGY (in Marathi). By Vishnu Narayan Gokhale, B.Ag. B.Sc. (Lecturer, Agricultural College, Poona) and Vasudev Ganesh Deshpande, B.Ag. (Lecturer, Agricultural College, Poona).

Teachers of Nature Study in the Marathi-speaking areas of the Bombay Presidency will welcome this volume. It deals thoroughly with animals of various types in language easily understood by school children. The printing is good. The drawings are numerous and excellent, and the size and price of the book are moderate. The authors are two of the junior staff of the Poona College of Agriculture and are to be congratulated on their very useful contribution to vernacular scientific literature. We trust that the book will have a large sale in the Marathi-speaking areas.

W.B.

3. 'A BIRD BOOK FOR THE POCKET.' By Edmund Sandars. (Oxford University Press. 7*s*. 6*d*. net.)

The little book that lies before us is of no importance from the point of view of scientific ornithology. The author in his preface admits the fact and expressly states that he does not claim to have added to existing knowledge. He has merely tried to make a handy pocket book in which a resumè of the chief facts in the life history of the ordinary British Birds is accompanied by 'a just picture of their beutiful forms and colouring'. We have therefore to judge the author's book merely in the light of the success with which he has attained his own objective. The illustrations are certainly no just picture of beauty of form or colouring. With scarcely an exception the shape, attitude and drawing of the birds is faulty while the colouring is crude and poorly reproduced.

The text is rather better. The short space of half a page allotted to most species is used to the best advantage with short crisp word pictures of the salient features of the bird's life, habits and characteristics. These are well expressed and accurate, though they tend to become mechanical and do not rise to special cases. For instance neither illustration nor text would help a beginner to differentiate between Willow-Wren and Chiffchaff except by their songs. Ten pages are given to a general introduction which describes briefly the leading characteristics of birds. This is helpful though it is disfigured by mistakes. For instance under the head of moult, currency is given to the mistaken belief in change of colour without a moult by a change of pigment in feathers; while the statement that a stock-dove usually makes a hole in which to build its nest, and that the 'the Bearded Tit and the Game Birds are scratchers of the ground' are samples of inaccuracies that spoil the introduction.

Finally there is a general chapter on eggs with indifferent coloured illustrations of a few general types. The index omits the scientific names but gives English and local names and a glossary of such words as seem to need explanation.

The idea and design of the book are very useful, but the execution might well have been improved upon.

H.W.

4. 'TIGER AND OTHER GAME' By Col. A. E. Stewart. London: Longmans, Green & Co. Ltd., 1927.

An excellent book. This and Dunbar Brander's are the two best books I have read. The way in which the book has been written and the variety of information and advice given by the author makes the work one of the most useful a novice on shikar could have. Col. Stewart devotes Chapter I to what he calls 'Preliminaries' and in this very sound advice is given on points of etiquette and politeness in correspondence with Government Officials on the proposed shoot and in dealings with the local Forest Officers and village Headmen, etc. The first portion of Chapter II also deals with this, and excellent advice is given on the proper way of treating a jungle

native, and the author is quite correct in saying that it is here that many soldier shikaries fail badly. The author has taken great pains to explain the whole procedure and methods to be adopted in beating for tiger and in sitting up for them. I notice that Col. Stewart takes an opposite view to General Wardrop with regard to following up wounded tiger. Col. Stewart considers that a tracker or two should go in front covered by the sportsman with his rifle at the ready; General Wardrop holds that the sportsman should be the one to go in front. I entirely side with Col. Stewart in this matter and agree with his methods. In his chapter on sitting up for tiger the author writes that a tiger when hit, if not knocked out, will usually charge in the direction he is facing and that a sportsman must have a clear view and steady aim if firing at a tiger facing him. As the book has been written, I take it, principally as a guide to inexperienced shikaries I think perhaps that the author might have said that on no account should a young shikari fire at a tiger facing him, but that he should get his sight on to him and wait till he starts to move off before firing. It is hardly likely that a novice on a tiger shoot would be absolutely steady in his aim, perhaps seeing his first tiger facing him, and a frontal shot in this case might be disastrous. I am glad that Col. Stewart is not one of those who absolutely ban the use of electric light when sitting up at night over a kill. In many parts of India, especially in the South, and where beating is impracticable, the use of artificial light is absolutely necessary.

Referring to the Sloth Bear the author remarks that it is a poor climber. Though I have never heard of a man being dragged out of a tree by a Sloth Bear I should hardly describe it as a poor climber. On the contrary I should say that the Sloth Bear is an exceedingly good climber and the height they will climb up a tree for figs and fruit is amazing.

Dealing with Bison the author writes that a tiger will think twice before he will tackle a Bison. I should say *Bull Bison* for I have known several cases of cows being killed, and three cases of Solitary Bulls being killed by Tiger, but I must admit that a tiger that can tackle and kill a Solitary Bull must be a large and powerful specimen.

I read the author's paragraph on sitting up over a wallow for observation with interest and pleasure, for this is what I enjoy doing exceedingly myself. If one has a permanent machan erected on a tree over a swamp or wallow the game get used to it and it attracts no attention whatever.

Writing on Grey Jungle Fowl the author remarks that he has never heard them calling on the ground and that he does not think they do. He is however quite mistaken here. Jungle Cock very often call on the ground during the daytime.

In his para on Taxidermists I think that the author's advice would have been better if he had said that heads and skins should be sent to the Bombay Natural History Society, Bombay, who undertake taxidermy work for its members, the standard of this work being equal to that produced anywhere, or to Messrs. Van Ingen and Van Ingen, or Messrs. Theobald Bros., both of Mysore. The Bombay Natural History Society employ the very latest methods and pay great attention to details. Living in Southern India I personally deal with Messrs. Van Ingen and Van Ingen and have always found them satisfactory, they are a most up-to-date and skilled firm, and it can be truthfully said that the Bombay Natural History Society and this firm turn out work equal to, if not better than taxidermists at home. This being so I see no reason for sportsmen to send their trophies home, especially as the author admits that duty has to be paid on the trophies if they are brought out again.

There is one excellent preservative which I see the author does not mention for preserving skins and that is Atlas 'S'. I think there is nothing like it for putting on skins if the animal is freshly skinned, to keep them in good condition in hot jungles. This preservative is now used by the chief taxidermists and tanneries in India.

The author's advice on rifles and ammunition is very sound indeed, as also is his advice always to have a medicine chest in camp.

The Autobiography of Shaitan Bhalu and the illustrated interviews are very good indeed and form a happily thought-out ending to a book which is full of sound advice, useful information, and interesting anecdotes written in a plain convincing style from start to finish.

This book should be in the library of every sportsman.

R. C. M.

EDITORIAL

In the last issue of the Journal we published the proposed **new constitution of the Society** and we invited criticism and in fact printed at the end of the Bye-laws a slip which would enable members with very little trouble to themselves to advise the Honorary Secretary what their opinion on the subject is.

Members will no doubt be anxious to know what the general opinion is—we are sorry to say the general opinion of members is 'You can govern the Society as you like, personally we do not care the value of the smallest Turkish co.n.'

Apathy—is it a tribute to the Committee? There has not been a single objection. All who have sent in their forms have approved, but 'all' is unfortunately not a word here which is an embracing one. It certainly does not embrace 'all' the members of the Society but embraces a minute number. The vast majority do not care.

If this attitude of the members towards the future constitution of the Society be an expression of confidence in the Committee, the Committee accept it but hardly with gratitude. They would be more grateful if members took an interest in what was going on; without interest being taken the Society is hardly likely to flourish.

Anyhow the response is sufficient to enable the Committee to go forward with the scheme and we hope by the time the next Journal is issued, to be able to announce that the Society is a registered Society and able to hold property and Government Paper in its own name.

The new constitution necessitates a close investigation of our **invested securities**—Do our investments equal the amount paid by living life members or are they too small or are they in excess? The Treasurer's Statement of Accounts should be in the next Journal, and will explain the actual financial situation of the Society better than ever before. The monies invested in, and derived from, the publications of the Society other than the Journal, and the income and expenditure of the Taxidermy Department will be separated from the regular income and expenditure of the Society under which head, as regards expenditure, will be taken expenditure which refers to every member of the Society—the issue of the Journal and the maintenance of the Society's Office staff, office and library. Without wishing to anticipate the Treasurer we can state here that our investments more than equal the amount contributed by living life members.

A question arises—if there be a surplus can that surplus be applied to any object the furtherance of which lies within the constitution of the Society, and if so, what would be the most pressing needs of the Society?

The most pressing need is a better illustrated Journal and perhaps the encouragement by a modest honorarium of those who write about Natural History subjects in a manner which appeals to the general member. The **Journal** must be our main recruiter and our binding link, but we want something more and we want a **good museum**—a museum for the student and research worker as well as a museum for the general public.

The arrangement the Society entered into, now several years ago, with the Bombay Government and the Trustees of the Prince of Wales' Museum, Bombay, has given members of the Society vastly improved conditions on those of old—though it was the personal care bestowed on the old museum that laid the foundations and enabled the superstructure to be erected. But no one will pretend that the existing building is suitable for a Natural History Museum nor that the accommodation provided is anything like sufficient for present needs. Members will be glad to know therefore that there is a possibility of the Trustees of the Prince of Wales' Museum being able to provide a **new building** for the needs of the Natural History Museum, and that the building, while in keeping with the noble architectural design of the late Mr. G. Whittett, will be one designed solely for the purpose for which it is intended to be used, namely a museum for the instruction of the public

by the display of Natural History subjects in scenery characteristic of that in which the fauna exhibited lives and has its being. For this we shall have to thank not only the Trustees and the Architect, but the man who went to America and Europe and learnt what a revolution in museum methods had taken place, and having digested what he had learnt, proceeded, after the manner of many good mothers, to give of the digested learning to the young around him.

The Trustees of the Prince of Wales' Museum will however experience difficulty in finding the money for the actual building, and the whole scheme may be held up unless some wealthy citizen of Bombay or resident in India comes forward with a generous donation to the building fund as did the first Sir Currimbhoy Ebrahim, Bart., for the existing museum. The fitting up of the museum when built must, however, be the work of the Society and here we may find the best use for surplus investments—always provided of course that the membership is sufficiently large to enable us to carry on the ordinary work of the Society without needing the interest derived from surplus investments.

Whatever this surplus may be, it will be but a drop in the ocean compared with what we need and we record therefore with great pleasure the appointment of **Sir David Ezra, Kt.,** as a Vice-Patron of our Society. Sir David is a citizen of Calcutta who has done much for the Calcutta Zoo and for the Zoological Gardens at Regents Park. It was Sir David who provided the funds for the despatch to Bombay of the Elephant for the London Zoo which the British India Steam Navigation Company so kindly took home free, and Sir Ezra's donation of Rs. 5,000 towards the furtherance of the Society's work is not only opportune and needed but of good omen.

We cannot say when this new building will be available but we are already planning **habitat groups**—groups which will enable the observer to realize what the animal, bird, insect or reptile is like in its natural surroundings, and we are already in possession of promises of support from members who are able to get us suitable trophies.

We welcome, and we aid, in the cause of Natural History those who come to India and Burma on behalf of Museums situated in countries outside the Empire; we realize that we shall benefit by studying their methods but why—why—should the British Empire be left out of it? Are we to rest content with the fact that if we want to see a good and representative exhibit of the fauna of the Indian Empire we must go to America to see it? It rather looks like it. The wild fauna of a country under modern conditions has no certainty of continual existence. In what museums are there specimens of the almost extinct Smaller One-horned Rhinoceros (*Rhinoceros sondaicus*) of the Sundarbands, Tenasserim, and the Malay Peninsula? We know of none where mounted specimens exist but there soon will be in America, thanks to the **forthcoming expedition of Col. Faunthorpe and Mr. Vernay.** We hope that someone connected with our Museum will be able to accompany these gentlemen or their Artist Assistants, and if so, we look forward to the publication of an interesting account of modern methods in the collecting field.

Our editorial in the last number of the Journal on **Game Preservation** has produced a certain amount of criticism—not as much as we should have liked in view of the great importance of the subject. Some of the criticism has been adverse owing to the non-realization of the fact that in making out a case for Game Preservation it was necessary to look at the question from all sides, and an article such as we have written would have been incomplete without some reference to the economic or, as we said, more 'material motives' for the protection of Game. The plea for protection of Big Game *per se* would not necessarily carry the same weight with all classes of people.

The word 'Game' as considered in the framing of laws does not limit itself to the class of animals usually sought after by the shikari but includes wild life as a whole and would include the smaller carnivora which are hunted and trapped for furs and which would equally require protection if they are at all to be considered as an economic asset and they are seriously so considered in other parts of the world but always in regions where they do not clash with agricultural interests. We have stressed this point in our article where we definitely state that the plea for protection cannot carry weight in urban lands and cultivated areas. Our whole plea for protection is concentrated on waste lands and in forest areas, where the interests of man are not brought into

conflict with the wild species and there are sufficiently large areas in India where these conditions prevail, which areas provide for the present the strongest guarantee against the extermination of wild life. The article was based mainly on correspondence received from members of the Society and was hence restricted in the main to such provinces from which information was available. We do not for a moment claim that it covers the question completely or is free from defects, but its purpose is to rouse interest and draw attention to a question which should be the concern of a Society such as ours.

We welcome all sane efforts to preserve the wild fauna of a country and in our next issue we shall refer once more to the work of the Society for the Preservation of the Fauna of the Empire with whom we intend affiliating.

In the present issue of the Journal we publish a review of Marius Maxwell's Book *Stalking Big Game with a Camera in Equatorial Africa.* A prospectus of Mr. Maxwell's book was forwarded to members with the October issue of the Journal and in the present number we have the pleasure of giving our readers a closer acquaintance with the author through the medium of his very interesting paper on 'The Home of the Eastern Gorilla'. Those who have seen Mr. Maxwell's book or have the good fortune to possess a copy, will realize that his magnificent series of portraits of African animal life require no commendation from us. The astonishing success achieved by the author led us to hope that someone would write the story of the Indian jungle as it never has been written before, in pictures of equal beauty and merit. Mr. F. W. Champion's book *With a Camera in Tiger-Land* fulfils this hope. Mr. Champion has done for India what Marius Maxwell, Dugmore, Schillings and others have done for Africa. He gives us intimate pictures of Indian animals in a setting which carries with it the spirit of the Indian jungle more effectively than pages of the printed word could have done. To those who love the Indan jungles—be they those to whom its sights and sounds are now but a happy memory or be they those who can still answer its call—we most heartily commend Mr. Maxwell's book and to the lucky latter we would add 'Go thou and do likewise'. The camera is increasingly becoming a competitor to the rifle in the hunting of game. **Hunting with a camera** has been rightly described as the expression of sport in its highest form. It requires all the qualities of hardihood, of daring and resourcefulness, of patient endurance and unflinching determination which are demanded from the ordinary hunter. Five years of continuous effort, Mr. Champion admits, have failed to produce for him a satisfactory picture of so common an animal as the Indian Sambhar although he has stalked to within a few yards of these magnificent creatures and could have shot a score of them in the same time. Hunting with the camera does not have destruction as its aim; it offers instead endless opportunities for the study, and enjoyable observation of wild life. It is no part of the camera hunter's business to frighten and disturb his quarry, and the trophies he obtains are far more interesting than any that could have fallen to his gun. The value and importance of his work in the faithful portraiture of animal life in its natural setting must increase as the inexorable march of civilization threatens, and will increasingly continue to threaten, wild life even in its uttermost retreat.

It is but too readily apparent, even to one only casually interested in the bird life of this country, how infinitismal is our present knowledge of **Bird migration in India** and how negligible have been our endeavours so far to further it, as compared with the efforts being made and the results achieved in Europe and America. No *systematic* effort has so far been made towards acquiring first-hand information regarding the movements of the hundreds of species that visit us year after year, the influx commencing about September-October and the exodus in March-April.

Individual observation is solely responsible for what little has been attained. Such observation deserves every encouragement and, in spite of the difficulties and shortcomings it presents, it is a mistake to underrate the value of such information obtained by careful study. An accurate record of the appearance and disappearance of a given species in any particular locality is manifestly of great value especially if the records for that locality extended over a number of seasons. By a systematic co-ordination of frequent and accurate notes of this nature it is often possible to learn something of the movements of

migratory birds even though it is but very occasionally possible to see anything of the migration in progress, and, unless it be on some isolated island on the route taken by birds, preferably with a lighthouse, as for instance Heligoland or Fair Isle (between the Orkney and Shetland group) it is extremely difficult for individual observation to obtain direct evidence of migration; on the main land, with its large and varied native population of birds, such a method can at best yield very patchy results.

As distinct from the purely observational methods of study, which can clearly be pursued only by a very few observers who are fortunate enough to be stationed in favourable localities, there is the modern method of bird-marking. The 'ringing' of birds consists of the fastening of a light aluminium ring of appropriate size bearing a stamped number and address, on the instep region or 'shanks' of trapped or netted birds. The birds are then released.

A small percentage of these 'ringed' birds are afterwards shot or recaptured in distant parts of the globe and the rings are returned to the marking station with data as to the exact locality and date of capture. When a large number of such records have been collected and correlated, it is possible gradually to build up knowledge of the routes followed in migration, and a number of other important facts also which could not have been ascertained by other means.

As an instance it may be cited that rings put on Storks in North Germany have been returned from Damascus, Alexandria, the Blue Nine, the Kalahari Desert, Basutoland and elsewhere, so that Dr. Thienemann, the Director of the German Ornithological Society's observation station at Rossitten on the Baltic Coast (E. Prussia), was able to conclude definitely that there is an autumnal migration of Storks from the shores of the Baltic to South Africa.

Some of the main problems whose solution we in India may in course of time look for to this method of marking are :—

(1) To what extent do our migrants return to their birthplaces to breed and under what circumstances are new areas colonized?

(2) Do birds take up definite quarters when visiting this country, and if so, do they seek the same year after year?

(3) To what extent do the birds of a single species occupying the same area during their winter visit, seek the same area for breeding in the northern part of their range?

(4) Are definite routes followed by birds, and if so what are they, and what is the nature of such routes (i.e. course of a river, etc.).

There are besides a great many other questions that need answering, and little can be achieved unless there is a general realization of the fact that our knowledge on any of the above heads is practically nil, and unless a properly organized and systematic effort is made on an extensive scale for the capture, marking and release of our migrants throughout the country. It will be recalled that possibly the only experiment of this kind in India was carried out early in 1926 by the late Maharaja of Dhar, an ardent sportsman and naturalist. The results of this experiment were published in the Journal (p. 1034 of vol. xxxi) and a further recovery—the most interesting of the lot—was recorded on p. 222 of vol. xxxii. The results must be regarded as highly gratifying and indicate the scope and utility of the ringing method.

The Society proposes shortly (provided sufficient encouragement is forthcoming) to launch on a campaign of bird marking, and we trust that all bird lovers and members who have opportunities will come forward and co-operate with us whole-heartedly. We propose to issue to members on request at a nominal cost, aluminium stamped rings bearing a number and the Society's address, to be fastened round the legs of birds. Perhaps a beginning could conveniently be made with waterfowl.

Along with the rings, a schedule will be supplied to the member on which data about all birds marked will have to be filled in by him such as (1) number on ring, (2) species of bird, (3) date of marking and release, (4) locality of marking and release and (5) sex and other remarks.

The completed schedules when returned to us will be posted up in a special ledger. Any recoveries recorded will be entered up, and the marker immediately informed.

We look to our sporting princes, District Officers and other members who may be favourably stationed to co-operate in building up the much-needed knowledge regarding the movements of our birds. All interested in the scheme

are cordially invited to communicate with the Honorary Secretary. Though the time is short let us hope a few thousand birds will have been ringed before the exodus commences in March and April.

We hope the present issue of the Journal will be appreciated but we have misgivings as to the future. We have very little reserve matter beyond a continuation of the interesting papers on Kashmir contributed by that veteran naturalist Col. Ward. Members have never let us down in the past and we appeal to them not to do so now.

We must congratulate our printers on the settlement of the industrial troubles they have been going through, and we hope that the year 1928 will witness the Journal issued with more regularity than it has been in 1927.

OBITUARY

Charles Eckford Luard

With deep regret we record the death of Lt.-Col. C. E. Luard, C.I.E., at his residence, ' Woodsend ', Boars Hill, Oxford.

Lt.-Col. Luard, a son of the late Col. C. H. Luard, R.E., was educated at Marlborough and Christ Church, Oxford. He came out to India in 1892 and after six years of service with the 8th Gurkhas was transferred to the Political Department as an assistant to the Agent to the Governor-General in Central India. The major portion of his service was spent in the Central Indian States and his long official connection and close study of these States made him perhaps the foremost authority of our times on this important group of Indian States. Although more of a ' Savant ' than a ' Political ' Col. Luard was esteemed and respected by all those he came in contact with both in his official and private capacity. He gained the warm regard of the ruling princes and was quite as popular with his European colleagues. Col. Luard wrote the *History of the States in Central India* and also compiled a valuable bibliography of that history. The portion of the *Imperial Gazetteer* dealing with Central India was prepared by him ; while his recognized intimacy with the history, people and rulers of Central India led him to be deputed on three successive occasions, viz., 1901, 1911 and 1921 to prepare the decennial census reports. Col. Luard joined the Society in 1906 and was a frequent contributor to the pages of its journal. In the present issue of the Journal we publish the last of the contributions received from his pen—' The Ornithology of the Bible'. Other articles by him of a similar nature, ' Deer Hunting in Shakespeare's Day ' and ' Shakespeare on the Noble Art of Hawking ' reveal his leaning towards this rather fascinating line of research.

Col. Luard, who was made a C. I. E. in 1923, married in 1903 Alice Margaret, daughter of Mr. James Todd of Aberdeen and leaves two sons and a daughter.

MISCELLANEOUS NOTES

I.—READERS' VIEWS ON 'GAME PRESERVATION IN INDIA'

You have started a discussion in vol. xxxi of the Journal, Nos. 3 and 4, and have invited others to give their views on 'Game preservation'. There can be no doubt that the preservation of Indian Fauna is a question requiring immediate attention.

In your article in No. 3, you go straight to the root of the trouble when you point out that it is the fact that game trophies, whether hides or horns, are allowed to be sold by law, which is mainly responsible for the heavy decrease of game in most districts.

There are two points I should like to touch on. You sum up as follows:—

'The impression gained from the letters read is that what is principally needed is a law forbidding the sale of any part of a big game animal.' So far so good. I heartily agree with this; *but* you go on to say 'carnivora excepted'.

Point No. 1. Why should Carnivora be excepted? I may say without fear of much contradiction that carnivora, i.e., tiger, panther, bear, afford just about *the* most exciting sport of any. Why then should they be excepted from a law which it is proposed to introduce in order to preserve big game for sporting as well as for Natural History purposes?

Another potent argument in favour of not excepting them from sale is this: Big game sportsmen do not (at any rate the true sportsmen certainly would not) ever sell any of their trophies, least of all tiger, panther or bear. It therefore follows that carnivora skins sold must be those killed either by poachers or by people who are not sportsmen at all but who merely shoot carnivora as matter of business, when they have the luck to be placed in the middle of the tiger and panther jungles, and are thereby selfishly depriving real sportsmen, who have probably spent a lot of money in getting to their blocks, of a chance of enjoying well-earned sport.

I therefore strongly urge that if any law is agitated for to be passed, it should be made to include carnivora, or at any rate, tiger.

Point No. 2. You go on to say 'Save by a Forest Officer in the public interest.' This requiries, I think, some elucidation. Personally, I would not leave any sort of loophole if the law is to be really effective. So many good laws have been rendered ineffective by some such weak clause.

Let us examine this second exception. In what exact public interest would it be to sell skins of any game animal, or horns? If it refers to shed horns, I fear that it would be only too easy for forest guards and coolies or others to shoot animals for food and produce their horns as picked up shed ones. I have not come across or heard of any district where horns and hides lie about in such profusion that it would be worth while collecting, advertising and selling them.

The amount realized I should say would not be commensurate with the labour and time of the forest guards wasted in searching the country for them.

I have recently been in one of the best districts in India for chital, hog and barking deer. Though of course they had shed their horns long ago, Chital were to be counted in herds of 200, swamp Deer I saw in herds of 50 and 60, hogdeer in herds of 20 (I counted 23 in one herd, which must be very unusual) and Barking Deer 5 and 4 together. Although I was moving all over the block for fifteen days all day and every day, I picked up 1 chital head and 1 horn of a hog deer.

I should be very glad if you can let me know what steps are being taken to get Government to pass legislation on this important subject.

Turning now to Mr. Brayne's suggestion, in No. 4 of vol. xxxi, page 1020. I certainly think something of the sort should be started. The syndicate idea, Mr. Brayne says, has already been turned down by the Forest Department, so I need not refer to it, except that one should like to know their reasons ? As regards his second suggestion, I think that a Game Preservation Society would be a first-rate scheme ; a definite organization like this would be of immense value in many ways.

For one thing, here you would have a big body of big game sportsmen which would, by fear of public opinion, greatly curtail the present shooting of wretched immature sambur, chital bucks, etc., etc. if it did not actually get legislation passed on the subject. It has always been a matter of astonishment to me that there are such excellent rules and penalties in the Kashmir Game Preservation Department and yet there are none in British India. The most that forest shooting-block passes do is to limit the number of heads one may shoot Nothing is said as to size, an equally important point if not more so. I have met young sportsmen in blocks who had not the vaguest idea as to what size a shootable sambur or chital was. The Kashmir Game Laws are to my mind the model of what Game Laws should be.

The Game Preservation Society, again, would in time be able to place the best material as watchers in the forests, with heavy penalties (such as loss of pay and dismissal) in case of bribery by poachers, etc.

Again, the Society would be able to assist its members in the many ways which a sportsman requires and which are now denied to him, unless he be a highly placed official such as the Governor of a Province, or unless he be a Policeman, Commissioner or Forest Officer. This particularly applies to the U.P., as only the above-named people can obtain elephants or beaters and other assistance. The ordinary sportsman (military or business man) is tremendously handicapped if he has to deal with a wounded tiger or panther. In fact, it is 100 to 1 against his getting it. Recently I had to leave a wounded panther (a very big one too) in my block, as I could not secure the services of any men, elephants or buffaloes to follow it up. I followed it up alone for hours, a most hazardous game, as one had to force one's way through thick long grass (over one's head) as quietly as possible, an very exhausting and dangerous



YOUNG LION ATTACKING A ZEBRA.

business. I had to give up in the end, leaving the panther as a potential source of danger to any forest people or others in the neighbourhood. Had I had an elephant, I could have followed the panther all day if necessary and of course with vastly increased chances of seeing it, looking down as one could have done into the grass. I may say here that I tried my best to get even one elephant before entering my block, but neither the civil authorities, nor the Forest Department could (or would) assist.

AJMER,
July 11, 1927.

W. M. LOGAN HOME,
Major,
4th Bombay Grenadiers.

[Although the extinction of the big carnivora would mean an increase in those animals which, when in large numbers, are a curse to the agriculturist, we do not think the prohibition of tiger shooting altogether by non-license holders or by any except sportsmen would be practical politics. It might be necessary—we can imagine several instances when it would be in the public interest—for the Forest Officer to shoot tigers and it would certainly be in the public interest for him to seize tiger shot contrary to law. Possessing the trophies, would it not be in the public interest for him to sell them for the benefit of the public? EDS.]

II.—A UNIQUE LION PHOTOGRAPH

(With a plate)

The accompanying plate of a young lion attacking a zebra is perhaps the most unique photograph ever obtained of a lion in his native environment. The photograph came into my possession through the late Mr. C. A. Latif, a prominent citizen of Bombay, who had resided in Zanzibar for a considerable number of years towards the end of the last century.

From the particulars furnished by this gentleman it would appear that the photo was taken by an engine driver on the then newly opened Uganda Railway, which as is well known, even now runs through some of the finest game country in the world. The engine driver got his camera ready to photograph a herd of zebras as they stood a short distance from the line, gazing in wonderment at the weird and unfamiliar object that had invaded their territory and rattled so glibly along the iron rails. The instant he pressed the shutter a young lion sprang from the surrounding scrub on one of the zebras, and this was the resultant exposure! If I have understood correctly, Mr. Latif was a passenger on this very train, but even if he were not, the driver was known to him personally and it was he that presented Mr. Latif with a copy of this remarkable photograph.

The coincidence and the circumstances sound positively miraculous and I should hardly have credited the account had it come from a less reliable source.

The photo was in Mr. Latif's wonderful private collection of curios collected all over the world and to my mind there appears no reason to doubt its authenticity and genuineness

Strangely enough I find the identical photograph considerably touched up and reproduced in Hutchinson's 'Animals of all Countries' (part iv, p. 173). All that is there mentioned about it is 'By permission of E. N. A.'

It would be very interesting to learn who 'E. N. A.' is, how the photograph came into his possession and if he has another version as to how it was secured by the camera-man.

BOMBAY NATURAL HISTORY SOCIETY, SALIM A. ALI.

6 APOLLO STREET,

September 5, 1927.

III.—WHITE TIGERS

(*With a photograph*)

I have recently had the luck to shoot a white tigress and would like to know if any other members of the Society have ever done so. I may mention that, not long after, a lady, Mrs. Murphy, wife of Mr. P. W. Murphy of the I.C.S. of this Province, also had the good fortune, when out with me to bag another one, also a tigress, and very much the same colour as the one I got. The animal I shot was pure white with black stripes on her body and russet brown ones on the tail. Both were well grown beasts, thick set, and taping respectively, 8′–5½″ and 8′–2″ between uprights. They were shot in the same jungles, but about twenty miles apart, in the district of Bhagalpur.

I enclose a photo of the animal I shot for publication in your journal if you like. The taxidermists to whom the trophy was sent report that during the year 1926 they received three white tiger skins including mine (mine was shot on December 6, 1926), but my skin is the only pure white one, the other two being cream coloured.



The animal was not an albino, as it did not have pink eyes, but the ordinary coloured eyes of a tiger, and so did Mrs. Murphy's. Is it possible that there is a distinct breed of white tigers, or are they only freaks? I have for years past been told by my shikaries that there was a white tiger in the jungles near here, quite twelve years ago. Herders who saw the animal, described it as *ek dum gaike māfik safèd* (white like a cow). I never believed them till I shot the tigress which must be a descendant of the white one seen by the herders years ago. Both the tigresses were young animals, about three or four years old. I once did see a white animal pass a little distance from a kill which I was sitting up over, and at the time thought it must have been a hyæna. It was bad moonlight and in thickish jungle, but I was rather suspicious at its making no noise in the leaves, which a hyæna usually does with its clumsy tread. I now think it must have been a white tiger. Both the above tigresses were shot in a beat, and took a good deal of lead. I hit my tigress from about twenty yards away through the right shoulder, bowling her over; she however managed to scramble away, and I missed with the second barrel. I followed her up soon after for about 100 yards, but did not find much blood, and had to give up for that day as it was getting late. The next day I found her fully 1000 yards away from where I originally hit her and polished her off with a shot through the neck. On skinning her I found that my first shot had gone through the shoulder and the bullet or rather parts of it were found under the skin on the opposite side, her liver being in shreds. Surely it is exceptional for a wounded tiger with such a fatal shot to go so far. The bullet used was a Contractile from a smooth bore (12-bore).

I shall be much interested to hear what information you can give me in regard to white tiger.

F. B. ROBINSON.

SAGRAMPUR,
BIHAR AND ORISSA,
January 28, 1927.

[Mr. Robinson's tigress is yet another of the many examples of complete or partial albinism recorded among tigers in recent years. Partial albinism is defined as a condition in which certain areas of the body remain marked by more or less well defined areas of colour owing to the presence of more or less pigment. It is believed that a pigmented animal owes its colour to the power that certain tissues of its body possess to secrete tyrosinases (oxydizing ferments) and chromogenic substances—the colouration being the result of the action of the ferments upon one or more of the chromogens and the theory is therefore put forward that an albino is an individual whose skin lacks the power to secrete either the ferment or the chromogens—it may hold one of these substances, never both.

But the presence of both these colour determinants are not alone sufficient to explain the development of colour which is arranged in animals in a definite pattern, either self, spotted, striped, etc., and it

is believed that colour is correlated with some other factor which determines the pattern—each special pattern having its own determinant and it has been shown that, while an albino may not possess the factors which determine colour, it may still possess factors which determine pattern, both visibly in the body tissues or as a gametic character; when its presence will only be detected in subsequent generations.

The frequent records of white tigers in recent years has been remarkable. On looking through our Journals we find no less than seventeen distinct records of white tigers shot in India during the last twenty years—a period during which certainly less tigers were shot than formerly if we are to credit the records of the old Sporting Magazines. The question arises as to whether these frequent records can be looked upon as instances of variation tending to the formation of a new variety or race. If there is anything in the theory of protective colouration in reference to the tiger, then the white colouring would be an obvious disadvantage militating against the establishment of such a race, and yet these tigers appear to thrive quite as well as the normal coloured animals from the fact that their records are becoming more and more frequent.

Do white tigers breed white tigers is a question on which naturalists and sportsmen are, as in the case of black panthers, inclined to differ. The white tigers of the Rewah State would appear to belong to the same family and to have bred white for several generations. Mr. Robinson assumes his tigress to be the offspring of white parents. The black panthers in the Kolhapur Zoo have bred black panthers for several generations. Eds.]

IV.—A TUSSLE BETWEEN TIGER AND BUFFALO BAIT

Whilst shooting in the Central Provinces in February this year, a buffalo calf, tied up for a tiger bait, showed signs of a struggle with a tiger when visited in the morning. Unfortunately, having injured my leg, I was unable to go and see that calf but several independent witnesses and a reliable shikari were all questioned and no discrepancies occurred in their answers.

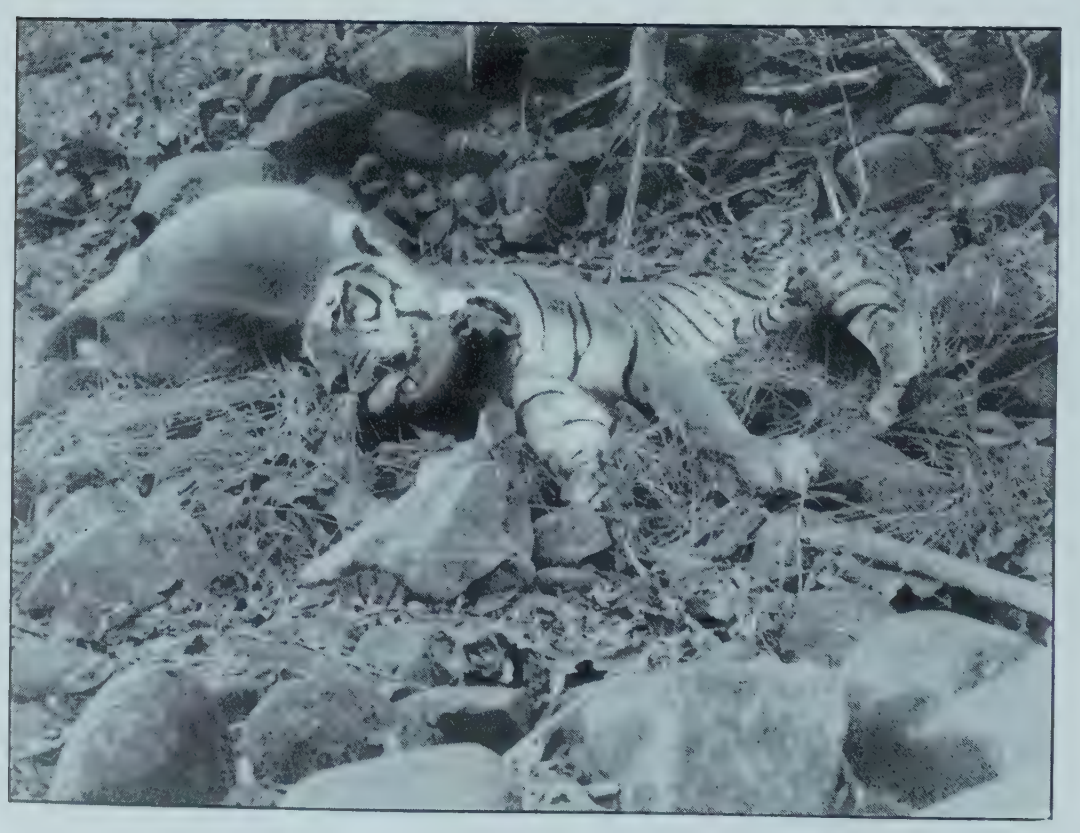
The calf bore marks of claws and teeth all over its back and, though it had subsequently to be destroyed, was still alive. Its horns were covered with blood and tiger's hair and it must have given nearly as good as it took.

A tussle between a 2½ year old tethered calf, and a tiger strikes me as rare; the tiger may have been frightened off by passers by, but even so the tussle lasted sufficiently long for the tiger to inflict a large number of wounds and the incident is an example of the stubborn courage of the domestic buffalo.

United Service Club,
Pall Mall, S.W.,
June 7, 1927.

J. Mc. C. CLIVE,
Captain, M.C.





A Tigress and its Kill.

V.—UNUSUAL BEHAVIOUR OF A TIGRESS WITH LIVE BAIT

(*With a plate*)

I have recently been shooting in the C. P. with Capt. Graham of this Regiment. We found we had to deal with a tigress which would not return to her kills, so we took it in turns to sit up over a live bait. On the third night the tigress attacked the bait at about 12·30 a.m. Capt. Graham saw the tigress standing firmly with all four feet on the ground and holding the side of the buffalo calf's throat in her jaws. In this position she pinned the animal's head to the ground.

It was in this position that Capt. Graham shot the tigress, which fell dead on the spot.

In the morning I went out and photographed it, and I now enclose the prints, which may possibly interest you or some of the readers of your Journal.

THE RIFLE BRIGADE,
LANDIKOTAL, INDIA,
June 3, 1927.

F. O. CAVE,
Captain.

VI.—WHAT IS THE RECORD PANTHER?

I read a remarkable statement which I expect a good many other members of the Society will also have read, in the issue of the *Sporting and Dramatic* for July 6, 1927, as follows:—'Rowland Ward's Records gives the length of a leopard killed in S. Nigeria before skinning as 9 ft. 3 in. while the record Indian specimen is one from Kashmir measuring 9 ft. 1 in. The average of a good Indian panther, before being skinned ranges from 7 ft. 9 in. to 8 ft. 6 in.' Now this statement is absolutely contradictory to all previous records, observations and articles appearing in any of the Society's Journals and also in any standard work on Big Game Shooting. I refer readers particularly to Col. A. E. Ward's able and authoritative articles in vol. xxix, No. 1, page 25 and vol. xxxi, No. 1, page 3.

As I have quoted the *Sporting and Dramatic* article, I propose to do the same with Col. Ward's observations.

'There is no doubt that an animal 8 ft. length measured between 'pegs, or even by taping from the nose between the ear and then 'straight to the tip of tail, is very rare.'

Col. A. E. Ward then gives a table of record leopards the biggest of which is 7 ft. 5½ in.

Again 'A full grown male leopard may be from 6 ft. 9 in. to '8 ft.; an eight-foot leopard measured between pegs is very un-'common. In Rowland Ward's Records of Big Game a measure-'ment of 8 ft. 3 in. is given and 8 ft. is recorded of two specimens 'at least; and then we have 7 ft. 6 in., 7 ft. 5½ inches.'

With all the above I most emphatically agree and all sportsmen to whom I have spoken on the subject have the same opinion. It is therefore most difficult to understand the statement made in the *Sporting and Dramatic* and I suggest the Society might collect

further opinions on it and at the same time ask the Editor of the *Sporting and Dramatic* to give further particulars, such as

(1) Who gave the information regarding these gigantic brutes of leopards (bigger than any tigress ever known and equalling most average tigers !) ?
(2) Who actually measured them and how ?
(3) What other witnesses were present ?
(4) The date and place where shot or otherwise killed ?
(5) Where are the skins now and what do they now measure?
(6) Will the owners very kindly allow two or three well-known big game hunters to view the skins ?

In this connection I might observe that the dressed skins would normally measure, for the 9 ft. 3 in. one = 10 ft. 10 in. and the 9 ft. 1 in. = 10 ft. 8 inch. As regards the Kashmir one it is difficult to understand how Col. Ward did not see or even hear of it. Is it in the Kashmir Game Records ? This point could be verified easily. If not, why was the owner so very retiring and modest after shooting almost the world's record panther ? !!!

As regards the statement that the 'average of a good Indian panther before being skinned, ranges from 7 ft. 9 in. to 8 ft. 6 in.', this is frankly incredible and gives a totally erroneous idea which I am sure the majority of big game sportsmen will not agree with.

AJMER, W. M. LOGAN HOME,
August 2, 1927. *Major.*

VII.—A PANTHER AND FLASHLIGHT

(With a plate)

This photograph of a panther was obtained in the foothills of Garhwal. The panther was fired at from a *machan* when it was just too dark to aim properly and within half an hour came back to its 'kill' in the open river-bed, 100 yards from the *machan*. It set off the flashlight, which makes a noise like a grenade, and yet returned and ate most of the 'kill' during the night.

Panthers in this part of Garhwal always return when they are fired at and missed. If, however, on their first approach they see anyone in a *machan* they will remain close by for an hour or so and then go away and do not return even when the *shikari* has gone home.

B. A. S. BRUNSKILL,
Major.

VIII.—BOLDNESS OF PANTHERS

I was out one morning alone after a Chital and was returning at 7.30 a.m. along the edge of the jungle. To my right was a vast expanse of open grassy plain known locally as a *Chauri*. I saw some animal a long way off moving from left to right out into the plain, when I got the glasses on to it, I saw to my surprise it was a fine panther, its coat glistening in the bright sun. I at once sat down and watched. It continued to walk along quite unconcernedly getting further and further out into the open plain. I guessed that it was making for a kill and this proved to be the



A PANTHER AND A COW "KILL."

(The Cow's nose appears just above the Panther's hind-quarters.)

case. It disappeared into some rather higher grass and then started returning with an animal in its jaws. I then commenced running, crouching through the grass, which was only knee-deep and managed to get within 300 yds. without the panther taking any notice though I was in full view more or less the whole time. I then saw that he would soon reach the edge of this jungle and so I took my chance and fired, and missed (the bullet went high and behind him). He dropped the kill and bounded off into the jungle. I got up and walked about 50 yds. when I saw him coming stealing back. I at once got into a sitting position again and fired when he had stopped to pick up his kill; but again missed. This time I ran crouching as hard as I could and made about 80 yds. and then sat down and hardly got into position when he again came stalking back out into the open, picked up the kill and walked unconcernedly off. I fired and this time hit him. He staggered off and when I reached the spot, I found it was a full grown Kakur he had been carrying. I went back to the bungalow and got three men and tracked the animal. I think this is a remarkable case of boldness and fearlessness on the part of this panther.

On another occasion, a few days later, I sat over a fresh kill (a cow) which had been dragged over 400 yards. I was in position at 6 p.m. and my man left me at that time. At 6.10 a magnificent panther arrived, quietly walked up to the kill, never looking to right or left, and at once seized it in his powerful jaws and began dragging it off backwards. I got him through the back of the neck and he died then and there, biting his left fore arm in his jaws. My man had only gone about $\frac{1}{4}$ mile and in fact was still walking away when he heard the shot. The panther must have been sitting waiting within earshot and close indeed.

While on the subject of panthers, I should like to protest against a statement I read in a big game book recently that 'the panther looks what he is, a perfect swine, while a tiger always looks a gentleman!' I think that is a remarkable statement, and personally I (and a great number of sportsmen agree with me) have exactly the opposite opinion. In view of my recent experience in the Terai, I consider a panther is a most sporting animal and gives one a very good chance, whereas a tiger is a skulking nocturnal beast, who has to be driven out to the guns; he very rarely ever comes to a kill in daylight, and curiously enough the book I mentioned brings out this very point.

A tiger more often than not will not return to its kill even when not tampered with, whereas the sporting panther comes back to his kill even when one has dragged it 100 yards and often to only a head and a few bones. Such is my experience and it is the experience of a great many more experienced shikaris than myself. Take again the case of man-eaters; far more tigers become man-eaters than ever panthers do. I wonder if the author of that statement considers *man-eating* tigers as gentlemen!!

AJMERE,
July 8, 1927.

W. M. LOGAN HOME,
Major,
4th Bombay Grenadiers.

IX.—CIRCUMSTANTIAL ACCOUNT OF A PANTHER ATTACKED BY WILD DOGS

The following may be of interest to members :—

Whilst shooting in the Central Provinces a few years ago a friend of mine found a panther in a dying condition. When dead, the panther was brought into camp and examined and skinned. The animal had been emasculated, the wound thus formed including the anus, no other wounds being found.

On removing the skin it was found that practically the whole of the entrails had been drawn out through the wound.

The only possible explanation was that this was the work of *Cuon* ; both my friend and his brother, who was present, are experienced shikaris and their veracity cannot be questioned.

The panther may, of course, have been in a feeble condition when attacked but even so the occurrence is remarkable.

I cannot think of any other possible explanation. My informant emphasized the fact that the panther was alive when found.

UNITED SERVICE CLUB,
PALL MALL, S.W.1,
June 16, 1927.

J. MC. C. CLIVE, M.C.,
Captain.

[In vol. v, p. 191 of the Journal, there is an account of a pair of panthers being treed by wild dogs. The two panthers were in a 'Sallai' tree, one above the other with a large pack of ten or twelve couple of wild dogs moving about below. A similar instance is recorded in vol. xviii, p. 194 of the Journal, in which a pack of wild dogs was seen in pursuit of a female panther. R. C. Morris in a note on wild dogs, vol. xxx, page 691, says he saw the remains of a panther that had been killed by wild dogs. It seems well established that panthers are occasionally attacked and killed by wild dogs—bears have also been attacked—while the belief is current that even tigers are not free from attack from these vermin—but the cases so far recorded in reference to tigers are based mainly on hearsay evidence. As regards the dogs having emasculated the panther, see Note No. XI on the opposite page. EDS.]

X.—WILD DOGS

There has been some correspondence about wild dogs lately. It has been alleged that there are two species (which I do not believe) and mention has been made of the colour of the tip of the tail. I have just received from the American Museum of Natural History, New York, three specimens, about two-thirds grown which were shot *from the same small pack* by Kunwar Dillipat Shah of Khairigarh. One of these has a black tip to the tail, another has a few white hairs, and the third has a distinct white tip to the tail like that of the silver fox. These three dogs were presumably of the same litter of puppies.

ORIENTAL CLUB,
LONDON,
September 3, 1927.

J. C. FAUNTHORPE,
Colonel.

[Only two species of wild dog have hitherto been recognized: *Cuon dukhunensis*, the wild dog of the whole of India and *Cuon rutilans*, the wild dog of Burma and the Malay countries. There is however a belief prevalent in India from Kashmir to Cape Comorin that there are more than two species and that in addition to the '*Jangli Kuta*' of the plains there are two hill kinds, one larger and the other smaller—the small breed is said to limit its range to the low ravines and to restrict its attacks to sheep and goat while the larger breed hunts in the higher mountains. It has been suggested that the smaller breed is really a pack of females and cubs, the mother training the young idea in the arts of hunting and naturally blooding them on easily killed quarry, while the full-grown packs roam the forest attacking what they may. EDS.]

No. XI.—HOW WILD DOGS KILL THEIR PREY

A recent issue of the Journal, vol. xxxi, page 813, contained an account of a sambhar stag in Burmah having been emasculated by wild dogs and the affirmation of the local shikaries was that this was their invariable practice. As the article implied a contradiction of my remarks on the subject in 'Wild Animals in Central India' which was referred to, perhaps you will be good enough to publish what I believe to be the explanation of this widespread belief.

Anyone familiar with the East knows of the exaggerated importance attached to anything connected with the organs of reproduction. The very idea of emasculation is horrific! Occasional and isolated instances of this having taken place are discussed with bated breath, possibly dwelt upon with a lascivious satisfaction. That emasculation 'may' take place immediately becomes that it 'does' take place. The mind of the jungli native construes this as a dreadful and purposeful action on the part of the wild dog.

Now for the fact that emasculation occasionally takes place and the explanation thereof. When an animal is attacked at bay the dogs launch themselves on the head and seize it clustered like ticks on every conceivable place. If the pack happens to be a large one there is no room on the head for those diffident in attack and so these immediately attack the hind quarters. This is the normal procedure generally of a pack of dogs. It constantly happens when a bobbery pack attacks a jackal or a pie dog. The victim is seized at both ends and stretched.

It would be surprising if under such circumstances some dog did not find the scrotum and testicles of any stag a most convenient mouthhold and that before the struggle ceased these did not occasionally become detached. That emasculation is either a common or a deliberate act I can deny from a wide personal experience of the wild dog and its habits.

I have now explained how this operation is sometimes performed fortuitously and I have suggested how an 'occasional occurrence' has been converted into an 'invariable practice' in the natives' mind.

Anyone reading *Wild Animals in Central India* will see that I state as follows :—

"The story to the effect that they (wild dogs) are in the habit of emasculating the animals they attack can be discarded". This sentence was purposely worded so as to make it clear that although emasculation might sometimes take place it was not habitual. The habit is denied, the act is not.

IVY BANK, ELGIN, SCOTLAND,
August 14, 1927.

A. A. DUNBAR BRANDER.

[The belief that the wild dog emasculates its quarry is very prevalent in India, as also is the belief that they sprinkle bushes with urine and drive their prey through them and then rush upon their quarry which is blinded by the acid fluid ! Emasculation does occur but is, as pointed out by Mr. Dunbar Brander, the result of chance and not of deliberate effort. EDS.]

No. XII.—THE RECORD FOUR-HORNED ANTELOPE (*TETRACEROS QUADRICORNIS.*)

(*With a photo*)

In February of this year we received a very fine head of this animal for mounting, shot by Col. E. Conway-Gordon in the Central Provinces. On examination the rear horns proved to be far above the known record and the fore-horns also exceeded those of the best head.





ABNORMAL BLACKBUCK SHOT IN BIKANER.



A GOOD CHINKARA HEAD FROM BIKANER. HORNS, 14¼″.

The measurements were taken when the head arrived and then again at the time of writing, when the head was completed and thoroughly dry. It will be seen from the table given below that there has been a considerable amount of shrinkage.

	Length of rear horns.		Length of fore horns.		Circumference.	
	R.	L.	R.	L.	Rear.	Fore.
On arrival	$3\frac{3}{4}''$	$7\frac{1}{4}''$	$2\frac{3}{4}''$	$3''$	...	...
On September 9, 1927 ...	$3\frac{3}{4}''$	$6\frac{3}{4}''$	$2\frac{3}{4}''$	$2\frac{7}{8}$	$2\frac{3}{8}''$	$2\frac{3}{8}''$

The right rear horn is broken as will be seen from the accompanying photograph. The core of this horn travels right up its length and measures $3\frac{1}{2}$ inches. The core of the left rear horn on the other hand is very short being only $1\frac{3}{4}$ inches.

The rear horns spread outwards and owing to their being broken the tip to tip measurements cannot be taken. The front horns converge inwards and the tip to tip measurement between them is one inch.

The best head in Rowland Ward's ' Records of Big Game ' (1914) measures: rear horn $4\frac{1}{2}''$: fore horn $2\frac{3}{4}''$.

BOMBAY, C. McCANN.
September 9, 1927.

XIII.—ABNORMAL BLACKBUCK AND A GOOD CHINKARA HEAD FROM BIKANIR

(*With a plate*)

I am enclosing two photographs which I trust will be of interest to you. The blackbuck carries an abnormal head, as is clearly seen from the photograph, and was shot by His Highness the Maharajah of Bikaner in the north of the Bikaner State at Hanumangarh. The chinkara, which measured $14\frac{1}{4}''$, was shot in the north of the State near Ganganagar by the Maharaj Kumar Sahib. It is practically a record for Bikaner ; only one bigger head measuring $14\frac{1}{2}''$ is known to have been shot in the State so far.

BIKANIR, SURAJMAL SINGH,
RAJPUTANA, *Secretary to*
August 31, 1927. *Sri Maharaj Kumar Sahib.*

XIV.—CLICKING NOISE MADE BY MUNTJAC

I remember having read in some of your Journals different articles attributing the curious clicking sound made by the Barking Deer to various causes. While at the local Zoo sometime ago I was watching the Muntajc in the enclosure, when I suddenly heard the buck making this peculiar noise. The little animal was on the other side

of the railing to me and not more than about a yard away. It was moving to and fro parallel with the railing and clicking away merrily. I sat down and watched it most carefully for a long time and found that the noise was distinctly produced by the animal's mouth. The clicking noise was made with the tongue and the lips at the same time, much like a clucking hen. The mouth was not open but every time the tongue clicked the ends of the lips were drawn back. I asked the keeper, and he informed me that this often occurred and was a sign of pleasure. Recently Mr. C. Raitt of Faith Estate, Kutta P.O., S. Coorg, was with me at the Zoo and he also heard the same noise and said it was made by the mouth.

I have seen it stated by some that the noise was made by moving the tushes in their sockets. This is a physical impossibility, because the tushes, although set loosely in their socket are yet imbedded in a cushion of muscles and flesh; which excludes all possibility of any clicking sound being produced, though the tushes could be moved about to a certain extent by external means and not by its own power. Whether the doe also makes this clicking sound I am unable to state, but I do not see why she should not be able to.

I have also read that the clicking noise was made by the hoofs but I do not think this is correct.

MYSORE,
S. INDIA,
September 2, 1927.

CHARLES THEOBALD,
F.Z.S.

XV.—THE BRAY OF THE CHITAL STAG

My attention has been drawn to Miscellaneous Note No. III, page 694 of vol. xxx, No. 3 (which I have somehow missed seeing before). I refer to the note on the Chital.

Mr. Morris says, 'I would not describe the call (*sic*) as in the nature of a whistle at all.' I presume he refers to the rutting season 'roaring' of the stags; personally, I quite agree with him. The chital stag's *roar* in the rutting season is, at any rate, from the Siwaliks to the Terai, very much the same as any other stag's roar, and certainly the Terai and Siwalik stags' roar could not be called a whistle, whereas their alarm note *is* distinctly a kind of whistling cry, which the does also utter. To my mind the chital stag's roar resembles the Kashmir Stag's and Scottish Stag's roar only it is not so loud.

AJMER,
August 25, 1927.

W. M. LOGAN HOME,
Major,
4th Bombay Grenadiers.

XVI.—MUSTH IN ELEPHANT

Col. G. H. Evans in his well-known book *Elephants and their Diseases* opens his paragraph on musth with the words 'Male elephants and very rarely females, on attaining maturity, are subject to peculiar periodical paroxysms of excitement . . . to which the name of musth is applied. . . .'

In view of the above statement by such a well-known authority, it may be of interest to your readers to know that during the Departmental Kheddah Operations conducted by the Forest Department in the Goalpara-Bhutan Mahal, Assam, 1925–26–27, two female elephants exhibiting unmistakeable signs of musth have been caught.

The cases are as follows:

No. 1. A very large female elephant of the Kumeraband type was caught in November 1925. This elephant had very large tushes, and at first, from her size and build, might have been taken for a makhana. Although full grown she had never had a calf, and there is no doubt that she was barren. While in the stockade she gave a good deal of trouble and attacked her fellows and the koonkies, and eventually broke both of her tushes on a tree inside the stockade.

This paroxysm of fury while in the stockade was succeeded at the depot by an impassivity and 'don't care' attitude which was quite as remarkable. The temporal glands were greatly swollen and gave forth a profuse oily discharge. Her training proceeded with remarkable rapidity and she was able to go out without koonkies ten days after her capture. Shortly afterwards, however, symptoms of blood poisoning were observed, due to the severe wounds the broken-off ends of the tushes had caused in the mouth and the animal was released in an effort to save her life.

No. 2. A very large female elephant of the Kumeraband type caught in November 1926. This elephant was not of such fine build as the former and in addition had had a calf. Her temporal glands were swollen and gave forth a copious discharge. She seemed very drowsy while at the depot but her training proceeded without incident and she left for her owner's home about a month after capture.

The question as to what causes the condition of *musth* in elephants can be ascribed, is one that has not been satisfactorily answered. It is true that some bulls when in this condition court the society of females, but it is by no means an invariable rule and it cannot be dogmatically asserted that this condition is due to a lack of sexual gratification.

As regards both of the cases cited above they did not show any perceptible desire for male company at the time nor did tuskers or maknas at the depot exhibit any interest in them.

One cannot lay down conclusions from two cases only, but it seems clear that the symptoms of the condition in the male and female is exactly the same. First the violent stage in which all animals are attacked and pain does not seem to be felt. This is succeeded by a drowsy stage in which the animal takes its fodder as usual but seems oblivious of its surroundings, and the attack then appears to gradually wear off. In both stages the temporal glands are swollen and give out a characteristic discharge.

The first case apparently was captured in the earliest stages and the second in the latter stages.

Both these animals were caught in the month of November and in stockades which are a few miles off from one another. All the other numbers of the respective herds were normal.

Some years ago an Assamese gentleman, Rai Sahib Rajant Kanta Chowdhury of Sorbhog owned a female elephant which was locally known by a term which was the equivalent of 'female tusker.' This was a North Cachar elephant and owed its sobriquet to the fact that it had longish tusks and went musth regularly each year until its death recently.

Elephant attendants have told me that male elephants go musth up to an advanced age, in fact none of them could recall an elephant that had not gone musth even in its old age.

We shall not probably get an explanation of why female elephants sometimes exhibit these secondary sexual characteristics of the male until some anatomical light is shed upon the question.

The above lines are written in the hope that they may catch the eye of those interested in the problem and that some information leading to its elucidation may enlarge.

KOCHUGAON,
ASSAM,
January 5, 1927.

N. L. BOR,
Imperial Forest Service.

XVII.—A LARGE TUSKER ELEPHANT

The following are the measurements of the tusker elephant I wrote you about:—

Height at shoulder 10ft. 4½″.

	Length	Girth	Weight
Right tusk...	6′ 2″	21″	85 lbs.
Left ...	6′ 3″	21″	86 lbs.
		Total ...	171 lbs.

The above were taken in the presence of witnesses and certified measurements were sent to Rowland Ward. What struck me about the tusks was their girth and symetry—a perfect pair! As regards height, this is of course difficult to get accurately, but it was taken between uprights, and the least I could make it was 10′ 4½″; taken at the highest point of shoulder, I made it 10′ 9″, but did not think this possible after all Sanderson says about their being no such thing as a 10′ elephant. He was 65″ round the forefoot. I think there can be no doubt of his being a record for South India. Apparently the Senior Ranee of Travancore thinks so too, for all my offers to purchase the tusks have been refused!

CHITTAVURRAI,
ELLAPATTI P.O., *via* PERIAKULAM,
SOUTH INDIA,
July 27 1927.

A. W. JOHN.

[There is a note in our Journal, vol. xi, p. 335, by Lieut. S.S. Flower giving measurements of tusks of Indian Elephants in the possession of the King of Siam. The largest of these measured 9′ and 9′ 10½″ respectively; they belonged to an elephant which is said to have been ninety years old when it died at Bangkok and are easily the record pair for the Asiatic elephant. EDS.]

XVIII.—A GOOD NILGIRI TAHR (*HEMITRAGUS HYLOCRIUS*)

The following measurements of a Nilgiri Tahr, or Ibex, may interest you as they constitute a record for this district (High Range, Travancore). He was shot in May 1899 by myself :—

Length $16\frac{1}{8}$″ ($16\frac{3}{8}$″ when shot)
Girth at base $8\frac{3}{8}$″

A. W. JOHN.

CHITTAVURRAI,
ELLAPATTI P.O., *Via* PERIAKULAM,
SOUTH INDIA,
July 27, 1927.

[A fine head of a Nilgiri Tahr was recently presented to the Society by Capt. H. R. Irwin. It was shot in the Nelliampathy Hills, South India, and measured $16\frac{1}{2}$″, girth $9\frac{1}{2}$″ (*vide* Journal, vol. xxxi, page 520. EDS.]

XIX.—BIRTH OF FREAK CALF AT INDORE

(*With a photo*)

With reference to a paragraph which appeared in the Current Topics column of the *Times of India* last month, the following



30 HOURS AFTER BIRTH.

notes and enclosed photographs may be of interest to readers of 'Miscellaneous Notes' in the Society's Journal.

Early in the morning of August 19 last, at the house of Baddrudin in the Palassia Mohalla, Indore, a calf was born with a bifurcated head, having two separate muzzles each with mouth and nostrils complete. The head had four eyes, two of which, one on each side, appeared to be normal, while the other two, joined together in the middle of the forehead, were sightless and 'dead' looking.

The calf had to be hand fed as its head was too heavy for it to lift. It sucked with both mouths.

Its birth, on Krishna's Day (*Janma Ashtami*), caused great excitement at Indore, and thousands of people from the city and the surrounding country came to see it and make offerings—much to the joy of the lucky owner.

Of the three photos enclosed, one was taken when the animal was about thirty hours old, and the other two (one of which is a side view in which the head appears to be quite normal), when it was eight days old. The calf died on the twelfth day.

LAL BAGH, INDORE,
September 19, 1927.

C. E. D. MEARS.

[We are unfortunately able to reproduce only one of the photographs. EDS.]

XX.—AN EXAMPLE OF AN ASSISTED PASSAGE

On April 26, 1926, I sailed from Bombay in the S.S. *City of Exeter* which left about midday. About 3.30 p.m. I discovered that we had on board a single House-Crow (*Corvus splendens*) which had apparently failed to notice our departure in time. It looked rather bewildered at finding itself at sea, and grew more and more uneasy as dusk approached, launching out over the sea and then regaining the ship with difficulty. It was a dark dusky looking bird obviously of the typical race from Bombay, and not the pale *zugmayeri* which is the form at Karachi whence the *City of Exeter* had come.

The crow stayed with the ship for the next few days roosting on the rigging and receiving food and water by the good offices of the crew. We did not put in at Aden. We passed Perim on May 2 about 7–8 a.m. and after that I watched the bird making several attempts to fly towards the mainland which was visible. Its courage always failed however and it returned to the ship. By evening however it had disappeared and I was told that it had apparently flown on to another ship. Unfortunately this ship was steaming in the same direction as ourselves, or I might have told a good story about corvine sagacity in taking a ship back to India! As an observed example of how stragglers leave their habitat, this seems worth recording.

BATTLE, SUSSEX,
August 8, 1927.

HUGH WHISTLER,
F.L.S., F.Z.S.

XXI.—EXTRAORDINARY PUGNACITY OF THE RUSTY-CHEEKED SCIMITAR BABBLER (*POMATORHINUS ERYTHROGENYS*)

Last Sunday I went with a couple of friends for a jaunt in the car on the cart road in the direction of Tara-Devi. As it was a beautiful evening in the monsoons, we pulled the car up at the seventh milestone to admire the wonderful scenery, and above all the wonderful cloud effects that are only to be seen at this particular time of the year.

The country in the immediate vicinity is scrub oak. I happened to glance up the khud side, when I noticed two of the above-mentioned birds settle in a small oak tree about 90 feet above us. Keeping my eyes fixed on them, I noticed they were engaged in fighting. In a few seconds they both overblanced, and fell to the ground, and owing to the gradient of the steep hillside, they commenced rolling down the khud in our direction. So busily engaged were they in their fight, that they paid no attention to the car they were fast approaching. My friend Mr. Neville Cotton realizing he stood a chance of catching the birds, jumped out of the car, and stood with his hands ready open. On they came until they reached a stone wall about 10 feet high, which separates the road from the hillside. As they arrived at this point, they actually fell into the hands of my friend. On examining them I found that they still had no intention of giving up their fight, for one bird held the other's leg between his beak, while the other had a firm grip of his opponent's throat. It was no easy matter to separate them, anyhow after a little careful handling I managed to accomplish this, when both birds gave vent to their feelings by jabbing at my fingers. After their wrath appeared to have cooled down somewhat, I released them both, only to find they still had no intention of making friends, for all the trouble commenced afresh on a bush, about 100 feet down the khudside. A heavy mist soon obscured them from my view. Both birds were in deep moult. It would be interesting to know what all the trouble was about, and as I write this I wonder if they are still at it?

THE MALL, SIMLA, *July 25, 1927.* ARTHUR H. BERRIFF.

[As a rule, the best of good fellowship prevails among the babbler fraternity, though its members are susceptible to occasional paroxysms of violent rage when two or more members of a 'sisterhood' will go for one another with the utmost zest and fury. We have witnessed a somewhat similar incident to the one described by Mr. Berriff, the belligerents in this case being a couple of Bombay Babblers (*Turdoides somervillei*). An individual was seen furiously pursuing another on the ground over strewn foliage, stones and other impediments. They subsequently hopped on to a branch about 6 feet high whence they dropped in a tangle on the ground below lying on their backs and continuing to grapple fiercely with each other using bill and claws. We were able to approach near enough to cover the birds up with a sola topee without attracting notice.

They made good their escape, however, but no sooner were they out than the chase recommenced in all earnest.

A third bird here joined the fray and after the original opponents had come to grips and fallen to the ground a second time, the new-comer dropped perpendicularly on them and also got knotted up! EDS.]

XXII.—OCCURRENCE OF THE WOOD SNIPE IN THE CENTRAL PROVINCES

In February last, while shooting in the Mandla District of the Central Provinces, about five miles from Amarkantak, I saw a Wood Snipe (*Gallinago nemoricola*). Forsyth mentions having seen one once in the same district, otherwise I have never heard of the occurrence of this kind in the Central Provinces.

I should be interested to hear whether any other members of the Society have observed the species in the Provinces.

UNITED SERVICE CLUB,
PALL MALL, S.W. 1,
June 7, 1927.

J. MC. C. CLIVE,
Captain, M.C.

XXIII.—NOTES ON DUCK SHOOTING IN THE ROORKEE DISTRICT, U. P., IN THE YEARS 1903 TO 1927

(*With a graph*)

1. The record extends over 21 seasons from 1903 to 1927, with three gaps of single years, in 1909–10, 1915–16 and 1923–24. The bags were all made in the jheels formed by the Solani R., close to its confluence with the Ganges R., about 15 miles S.E. of Roorkee, in the extreme N.W. of the plains of the U.P. (and some 35 miles S.E. of Saharanpur). In the great floods of September 1924, both the Solani R. and the Ganges R., were in exceptionally high flood, and as a result almost all the jheels were completely blotted out by being silted up by sand from the Solani R.; so that where there used to be 6 ft. and 8 ft. of water in a jheel there is now dry land with grass growing: this area will therefore never again be attractive to duck, unless indeed another cataclysm occurs similar to 1924. The duck shooting in this district is therefore now entirely ruined, and a thing of the past, as proved by the figures of the years since 1924: I have therefore thought that it may be valuable to record the figures now before it is too late (especially as a record extending over 21 seasons in the same district is not frequently obtainable), as they may be of value in the study of the distribution and migration of the various species of duck in India. For the past three seasons 1924 to 1927, I estimate there have never been more than some 500 duck in all the area of the former jheels, where prior to 1924 there used to be from 6,000 to 10,000 at least all through a season.

2. The figures given in my Table are taken from my game-book, written up in ink at the time. I have always been in the habit of vetting the bag carefully on return to camp each evening

and morning, and recording the numbers of each species separately in the game-book. Capt. E. E. Searight, R.E., has very kindly verified the figures in the Table with my original game-book.

The figures in the Table have been plotted as three curves on the Chart shown, for easier analysis. The bags were all made by 'flight shooting', i.e., on birds moving naturally to and from their feeding grounds at evening and morning, and without any driving, etc. The duck shooting 'season' has been taken as from September 15 to April 15, but as a rule very little good is done before November 1 or after March 1 as the main body of the migratory duck arrive in the Roorkee District between November 1 and 15 usually, and leave again by end of February. The first species to arrive in any numbers are the White-eyed Pochard, Gadwall and the Common Teal, and the last are Wigeon and the Red-Crested Pochard; the latter are often not 'in' till middle of December, and they are also the first to leave. The last species to leave are the Garganey Teal (who moreover do not arrive in this district in numbers till February, presumably on their way back from further south; they do not seem to come to the Roorkee district on their arrival in India); also the White-eye and Gadwall stay late, some few even till April sometimes.

The 'evening flight' for record purposes has been taken as from 3.30 p.m., till dark (about 6 p.m.); and the 'morning flight' as from dawn till 8.30 a.m. or 9 a.m.; though on misty mornings the birds will flight till as late as 10 a.m. Shooting in the middle of the day merely spoils the evening flighting, and never leads to anything of a bag. There is usually a big afternoon flight which goes on spasmodically between 3.30 p.m. and about 5 p.m., apparently birds stretching their wings after their mid-day siesta. And the real 'evening flight' lasts from about after 5 p.m., till well after dark, these being duck going to feed.

3. The figures in the Table present several points of interest; the years 1906–7, 1907–8, 1908–9 were all exceptionally good years; and so were 1918–19 and 1919–20; also 1914–15 was good: in these years unusual numbers of duck arriving in this district. This is well shown on the chart: the red curve of 'Total Bag' showing 'peaks' for these years, corroborated by the blue curve showing the average bag per 'flight': from the green curve it appears that big bags of over 50 per flight are more numerous in the years when duck are more plentiful, as one might perhaps expect. The years 1907, 1908 and again 1918 were exceptionally dry years, when the monsoon practically failed in the Roorkee area; so it seems as if in a dry year more duck come to India; though another explanation may be that in a dry year the smaller outlying jheels are dried up and so all the duck are concentrated in the larger and deeper places, such as the Roorkee jheels used to be prior to 1924.

The 27th column of the Table, giving the average bag per 'flight' in a season, shows that one's average expectation in the Roorkee District was about 29·68, say 30 birds, and cutting out the last three years, 1924–27, when the conditions had radically altered for the worse, it would be about 40 per flight. And the last line of

the Table, showing the average numbers of each species, shows that in any bag one might expect to get 37 per cent. Gadwall, 13 per cent. Mallard, 11 per cent. White-eyes, 11 per cent. Common Teal and 7 per cent. of Red-crested Pochard: though of course any particular bag, owing to the nature of the place chosen as a stand, might consist almost entirely of one species, e.g., all Mallard with a few Common Teal if the place was in shallow water; and all Red-crested Pochards if the water were very deep, with perhaps a few Gadwall.

4. Some points noted in my game-book that are not shown in the Table, are of interest as regards the dates the duck arrive and leave; thus taking the different years:

1902–3: On October 18 (i.e., early in season), a morning bag consisted of 12 White-eyes, 2 Common Teal, and 5 Cotton Teal.

1904–5: On October 22 there were no duck 'in' at all: on November 19 a bag of 43, showing the duck came in between those dates: on March 5 (late in season) a bag of 31.

1906–7; Was an exceptionally good season: between April 8 and 11 (very late). 4 Gadwall, 1 Red-crest Pochard, 2 White-eyes, and 13 Garganeys were got.

1907–8: On November 8 birds were few, only 20 bagged: on January 27, 1908, all the Red-crests had left; (very early). This was a very good season, and a very dry year.

1908–9: On October 31 a bag of 24: while 69 were got on November 1, so the birds came in early this year: this also was a very good season, and very dry.

1911–12: On March 9 a bag of 40: the duck were leaving, and the weather very hot.

1912–13: A poor season: the Solani R. altered its course owing to big floods in 1912 monsoon.

1913–14: A good season: on November 8 a bag of 19 only, birds not yet 'in' properly; on March 1 bag of 20, birds leaving fast.

1914–15: On March 2 (full moon) three consecutive flights of 40, 41, 33: In monsoon of 1914 the Solani R. altered its course radically and formed several new jheels: a good season.

1917–18: On November 17 a bag of only 7: birds not yet arrived; this was very late: on March 23 only 3, birds having left: a very poor season with few duck.

1918–19: A very good season with exceptional numbers of duck. 1918 was a very dry year with no monsoon: on November 9 a bag of 55, the birds being well 'in'.

1919–20 : On November 15 a bag of 101. A very dry year, with very little water in jheels.

1920–21 : On November 27 a bag of 91, this was also a very dry year with no rain after August 20, 1920.

1922–23 : On March 9 a bag of 92, very late in season for a big bag. Heavy monsoon in 1922, and heavy rain in February 1923.

1924–25 : A very bad year : In September 1924 exceptional floods in Solani and Ganges R., nearly all the Solani jheels were silted up solid, and no longer existed after the floods.

1925–26 and 1926–27 : Both very bad seasons : there were hardly any birds throughout both seasons, owing to there being no water area for them to settle on.

5. *Numbers of the different species.*—The last line of the Table (in bold type), gives the percentage of each species shot, on the average of the whole period of 21 seasons ; it is interesting to compare these figures given for the U.P., east (district not stated), in the Table on page 59 of D. Dewar's book *The Ducks of India* (1925 edn.) ; his figures are the number of each species occurring per 1000 birds shot. It may be here noted that Roorkee is in the extreme west of the U.P., and there seems to be a considerable difference in the numbers of some of the species occurring in the east and in the west of the U.P. : most notably in the case of the Red-headed (or Common) Pochard, and the White-eyed Pochard and Garganey Teal, and to a less extent with Gadwall, Pintail, Spot-bill, and Common Teal.

Species	U.P. West (Roorkee) per 1000	U.P. East (Dewar) per 1000	Remarks Roorkee Nos. compared to U.P. East Nos. are
Mallard ...	130	110	Rather more.
Gadwall ...	373	150	2½ times as many.
Red-crested Pochard ...	74	80	About the same.
Red-headed (Common) Pochard.	56	15	Nearly four times as many.
White-eyed Pochard ...	116	270	Much less than half the numbers.
Pintail ...	22	40	Half as many.
Shoveller ...	37	30	About the same.
Spotbill ...	14	6	Twice as many.
Wigeon ...	21	16	About the same.
Common Teal ...	119	200	About half as many.
Garganey Teal ...	8	50	Less than 1/6 the Nos.

In the Roorkee District, the Gadwall (37·3 per cent) are the most numerous species, being three times as many as any other kind. Next come Mallard (13 per cent), the White-eyed Pochard (11·6 per cent), Common Teal (11·9 per cent), Red-crested Pochard (7·4 per cent), Common Pochard (5·6 per cent)—then the Shoveller only 3·75 per

cent ; while, Wigeon, Pintail, are only about 2 per cent each, and Tufted Pochard and Spotbill only 1·45 per cent each.

In some years exceptional numbers of particular species seem to have occurred in the Roorkee District e.g.

Mallard (normal 13 per cent). In 1906-07, 17 per cent ; and in 1908–9, 17 per cent were bagged.

Gadwall (normal 37·3 per cent). In 1906–7, 43·4 per cent; in 1919–20, 43 per cent : in 1920–21, 47 per cent ; in 1921–22, 60 per cent ; and in 1922–23, 47 per cent were bagged.

Pintail (normal 2·2 per cent). In 1907–8, 4·4 per cent ; and 1918–19, 5 per cent.

Wigeon (normal 2·1 per cent). In 1911–12, 4·2 per cent ; and in 1918–19, 4·3 per cent.

Red-crested Pochard (normal 7·4 per cent). In 1920–21, 15·3 per cent.

Red-headed (*Common*) *Pochard* (normal 5·6 per cent). In 1906–7, 8·5 per cent ; in 1918–19, 9 per cent ; and in 1920–21, 9·4 per cent.

White-eyed Pochard (normal 11·6 per cent). In 1908–9, 13·9 per cent.

Tufted Pochard (normal 1·45 per cent). In 1913–14 an exceptional increase of 10·4 per cent.

Common Teal (normal 11·88 per cent). In 1907–08, 20·3 per cent ; and in 1918–19, 16·6 per cent.

Apparently in the exceptionally good (and dry) years, such as 1906–7, 1907–8, 1908–9, 1918–19 the Mallard, Pintail, Wigeon, Common and White-eyed Pochards, and the Common Teal, formed a bigger percentage of the bags than in more normal years : while the commonest duck, the Gadwall, formed an exceptionally large part of the bags in only two of the exceptionally good years (1906–7, and 1919-20), and then again in three consecutive seasons (1920 to 1923) that were not remarkable for large numbers of duck.

6. Some further notes on the commoner species in the Roorkee District.

Spotbill. There are always in every year a good many small parties (two to six) about during the whole season, and they probably remain all the hot weather. All I have shot were the common form (*Anas p. pœcilorhynca*).

Comb Duck. These are uncommon, but one saw one or two about in most years, early in the season only ; though I shot a pair on January 11, 1915.

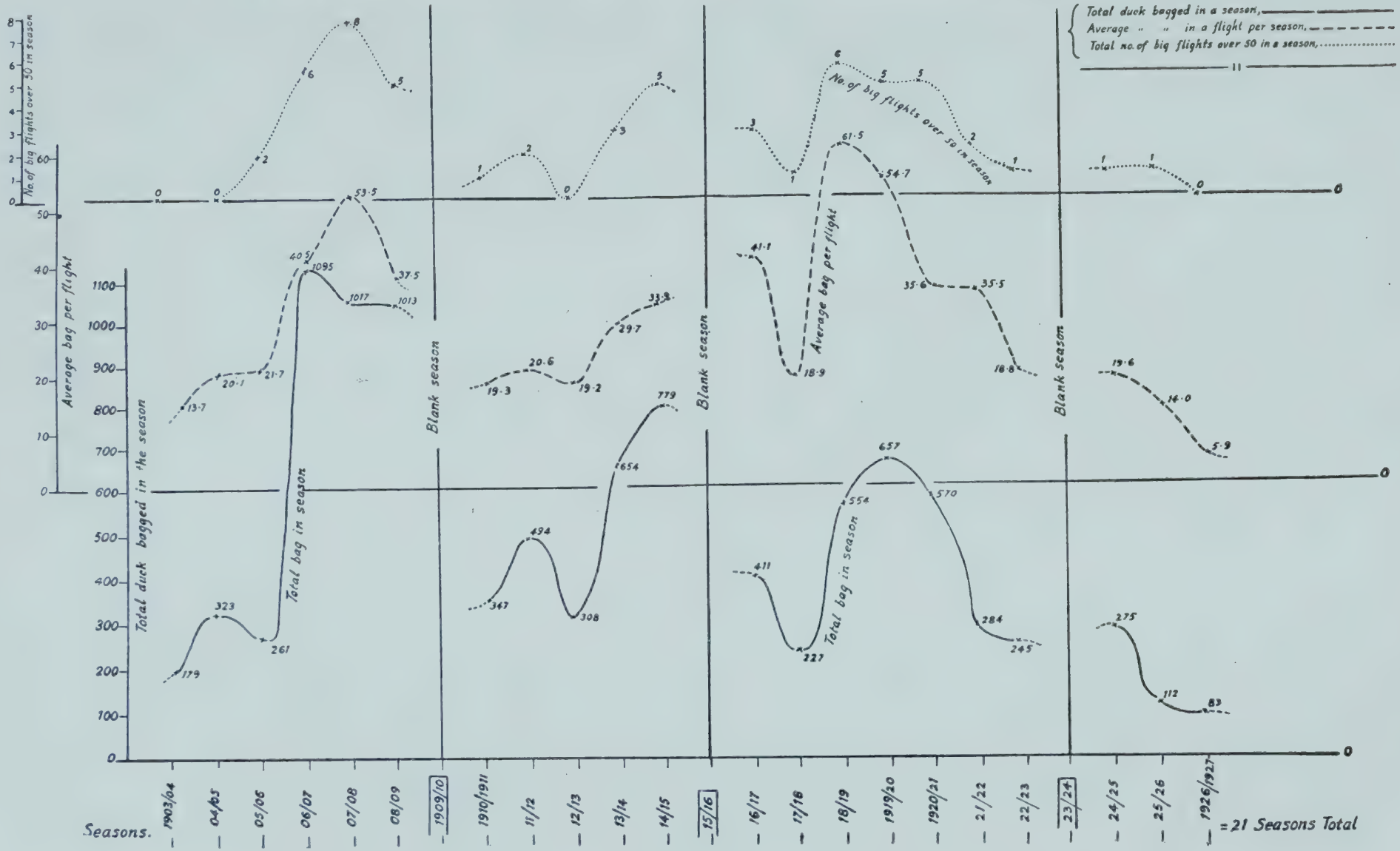
Cotton Teal. These are not common, but early in November ; a few are seen about in most years ; these appear to leave the district after November, presumably for the south.

Lesser Whistling Teal. Nearly every year I saw a few flocks about ; which disappeared after end of November, presumably to go east or south. I never happened to bag any in the Roorkee District, but other guns bag a few most seasons, always early in the season.

Pintail. These are not numerous, but every year there are a few flocks all through the season.

Wigeon. Also not numerous, but occur every season ; they come late (in December) and leave early (February).

Record of bags of duck made by flight shooting near Roorkee, U.P. in 21 seasons from 1903 to 1927, by Col: A.H. Cunningham.



Shoveller. These are fairly numerous in the jheels every season, occurring in scattered parties.

Red-crested Pochard. These occur every season, the big flocks arrive late (in December) and leave early. Owing to their occurring in big flocks, a big bag is often largely of this species.

Red-headed (*Common*) *Pochard.* Some come every year ; but they are variable in numbers from season to season, much more so than the Red-crests.

White-eyed Pochard. Is common every year and ubiquitous in the jheels: they come earliest of the migratory duck, and leave late: all I have shot have been the western form (*Nyroca n.nyroca*).

Tufted Pochard (*Nyroca fuligula*). These are never numerous ; but a few small flocks come every season.

Brahminy. Quite a few of these are always about in the jheels, though they are much more numerous in rivers such as the Ganges.

Common Teal. These are ubiquitous and common every year ; this year however, 1926-27, it was noticeable that there were hardly any.

Garganey Teal. Very few of these appear till February ; presumably on their return migration from the east ; they are then fairly common ; and stay last of the duck.

The Smew. A few scattered individuals occur most years.

The Goosander. I have never seen these in the jheels, but have shot them in the Ganges R. near Hardwar, where they are fairly common.

Geese. Both the Grey-lag, and the Bar-headed Geese occur in small numbers in the jheels in most years : the former being far more common than the latter.

7. The following duck are very rare in the Roorkee district :—

Golden Eye (*Glaucionetta clangula*). I shot one on February 20, 1911, and sent it to the Bombay Natural History Society for verification.

Falcated Teal (*Eunetta falcata*). I shot one on January 31, 1915, and one on January 28, 1917, both were sent to the Bombay Natural History Society for verification.

Common Sheldrake (*Tadorna cornuta*). I saw two of these birds flying with and leading four Brahminies, unfortunately my shot brought down the third bird in the line, a Brahminy ! ! so I was unable the make certain : but I am certain they were Common Sheldrake (of which I have shot several in Sindh), as the birds were well in shot and the light was bright, about 8 a.m.

Marbled Teal (*Marmaronetta angustirostris*).

Stiff-tailed Duck (*Oxyura leucocephala*).

The Scaup (*Nyroca m. marila*).

Specimens of these last three have to my knowledge been shot in the Roorkee jheels by other guns between the years 1892 and 1905.

ROORKEE, U.P.,
April 20, 1927.

A. H. CUNNINGHAM,
Colonel,

XXIV.—SNIPE AND WOODCOCK IN S. INDIA.

The following extracts from my Game Registers of the last four seasons, showing the different varieties of Snipe, and the number of Woodcock shot, may be of interest :—

Locality	Year	Month	Fantail	Pintail	Swinhoe	Wood Snipe	Jack	Painted	Remarks.
Ootacamund ...	1923-4	...	1	97	...	...	1	...	First shot Ocotber 19.
,, ...	1924-5	...	...	53	...	...	...	...	Last shot February 22.
,, ...	1926-6	...	...	48	...	1	...	...	First shot September 28. Last shot February 19. Wood Snipe January 2.
,, ...	1926-7	...	...	97	...	2	...	...	First shot September 23. Last shot March 5. Wood Snipe January 29.
Cannanore ...	1925	Dec.	18	53	2	...	...	...	...
,, ...	1926	Feb.	10	42	...	...	...	...	...
,, ...	1926	Nov.	23	130	1	...	2	2	...
,, ...	1927	Jan.	38	134	...	...	3	11	...
S. Mysore ...	1926	Jan.	23	30	...	...	...	4	...
,, ...	1926	Oct.	6	35	...	...	...	1	...
,, ...	1926-7	Dec.-Feb.	15	8	...	...	1	...	...

Locality	Year	Woodcock	1st shot	Last shot	Best day	Remarks.
Ootacamund ...	1923-4	14	Nov. 5	Jan. 26	3	Stopped shooting on January 26.
,, ...	1924-5	27	Dec. 12	March 9	5	...
,, ...	1925-6	14	Dec. 16	Feb. 19	7	A poor year.
,, ...	1926-7	24	Dec. 11	March 2	4	...

NOTES

Ootacamund.—Fantails are distinctly rare on the Plateau ; in fact, the one shot in 1923 is the only one I have heard of for some time. Wood Snipe are commoner in the Wynaad than up here, where only four or five are shot each season. I send for reference the wing of one shot last January.

Cannanore.—Pintails largely predominate ; occasionally one of the larger variety is noticed, e.g. six during 1927. I send for reference the tail of the last Swinhoe shot.

S. Mysore.—The Fantails included several more or less typical specimens of Radde's snipe, but unfortunately no record of them was made at the time.

Woodcock.—These seem to come in later than formerly, possibly visiting the Anamalais before arriving here. February is the best month and nearly all are gone by March 15, or earlier if heavy rain falls. I think 25 to 30 may be considered a good average season's bag, it being remembered that small game shooting on the Plateau is limited to two days a week. Three woodcock weighed on January 5, i.e. well in the season, were 10, 11 and 11 oz. respectively.

LOVEDALE,
NILGIRIS,
June 1, 1927.

E. G. PHYTHIAN ADAMS,
Major, I.A., (Retd.)

XXV.—A CORRECTION TO MR. B. B. OSMASTON'S 'NOTES ON THE BIRDS OF KASHMIR'

In Vol. xxxi, part 4 of our Journal, Mr. B. B. Osmaston has commenced a series of very valuable and interesting notes on the birds of Kashmir. He will perhaps forgive me for venturing to correct two of his identifications, as mistakes quickly gain currency and are endlessly repeated.

No. 75, *Acrocephalus concinens concinens.*—The Chinese Paddy-field Warbler.

A Paddy-field Warbler has been known to breed in Cashmere ever since Brooks first found an empty nest at Shupyion on June 13, 1871, and shot the male bird which is still in the British Museum. Yet though we have for some years known it to be common and Rattray, Wilson, Davidson, Bates and others have collected numbers of the nests and eggs, we cannot get its name right. In the last edition of the Fauna we find it shown under two species *Acrocephalus agricolus* (which may nest in Turkestan or the plains of India but certainly does *not* nest in Cashmere), and *A. concinens concinens* (which in my opinion does not occur anywhere in Indian limits). It remained however for Mr. Osmaston to collect a proper series of skins though owing to his departure for Africa he was unable to examine them critically and merely accepted the identification given in the Fauna. I have seen his series and also various other birds collected in the Cashmere jheels in the breeding season, 17 in all. I have no hesitation in saying that these birds agree with Harington and Whitehead's series in the British Museum from the Kaghan Valley, the type locality for *Acrocephalus concinens haringtoni*, which is therefore the correct name for the Paddy-field Warbler which breeds so commonly in Cashmere.

No. 77. *Sylvia curruca affinis.* Indian Lesser White-throat.

Both Dr. C. B. Ticehurst and myself have endeavoured for some years past to dissipate the legend that this species breeds within Indian limits, but it is repeated again and again like the mistakes over the Paddy-field Warbler. Mr. Osmaston kindly gave me two White-throats collected by him in the Suru Valley to identify his eggs. These are both specimens of *Sylvia althæa*, Hume's Whitethroat which is really the breeding Whitethroat of Cashmere. It

will be noticed in Colonel Meinertzhagen's account of his trip to Ladakh (*Ibis.*, 1927, p. 421) that he found *S. althœa* to be the common breeding bird of the Indus, Shyok and Nubra Valleys. Mr. Osmaston's mistake was of course due to his hurried departure for Africa before he could make a fresh examination of his skins, but I can only end by urging that for the present no egg collector in India, Cashmere or Baluchistan will name any Whitethroat's eggs without a skin from the nest to support his identification.

CALDBEC HOUSE, HUGH WHISTLER.
BATTLE,
August 30, 1927.

XXVI.—AN ALBINO TURTLE

On June 25, I secured a specimen of the Common Mud Turtle of these parts, *Emyda granosa intermedius*, Annandale, which is apparently an albino. It was a half-grown specimen and was bright yellow throughout with the exception of the limbs and neck which were chrome yellow. The plastron had the usual colourless appearance. It was taken in the Ambajheri Tank at Nagpur and is deposited in the Nagpur Museum. (Reptile No. 274.)

NAGPUR, C. P., E. A. D'ABREU, F.Z.S.
August 17, 1927.

XXVII.—NOTES ON THE DESERT MONITOR (*VARANUS GRISEUS*) AND THE SPINY TAILED LIZARD (*UROMASTIX MICROLEPIS*)

The following field notes may be of interest: they have been compiled from observation and the experience of Bedouin hunters. Most of the facts were obtained from Nahaita, an Araif tribesman, who has spent most of his thirty years or so of life hunting the wild animals of the Shamiyah Desert, and Radam, who has had a similar career. For their truth I cannot vouch, but both men are now in the Camel Police and are models of reliability when reporting, and of observation and knowledge when anything relating to the local stretches of Iraq and Najd is under discussion.

The Desert Monitor (*V. griseus*) locally known as the *harwhal*, ranges in adults from twelve to twenty inches in length. It is so called because it is never seen travelling at any other pace but that of a fast wriggling run. I have myself, however, seen them travelling at what could only be termed a slow stumbling crawl but this was in about twelve square feet of confinement.

They are easily overtaken by a running man. When neared, they stop, turning their heads with mouths wide open in the direction of their pursuers. They then lash their tails furiously from side to side and shoot their tongues in and out at the same time hissing loudly. If foot or stick is approached more closely to them, they will make sudden darts snapping fiercely at the offending object, and although the only result is bleeding and broken teeth, they persist in doing the same thing repeatedly.

I have found that the best way to catch them is by a sharp kick under the belly which bowls them over, a foot placed quickly on the head then enables one to pick them up by the tail when a noose may be easily passed over the head and up to the waist. I have never seen them biting the line that holds them captive.

These reptiles are found in the Shamiyah Desert and also in the Gizerah region between the Tigris and Euphrates. They prefer sandy places especially with mounds or undulations, and it is only when these are present that they are found in Subakha, a salt mud of treacherous consistency found in patches of varying size in the local desert.

Though they sometimes dig their own burrows, they more usually adopt the disused holes of other animals such as rats and jerboas. When its own excavation, the shaft is driven in at an angle of about forty-five degrees to a distance of roughly eighteen inches, the sunken end being expanded into a chamber. The outlet remains single.

They are said to feed on the surface only, never taking food below ground. No vegetation is eaten and they dislike water. Their food consists of crickets, small lizards and local desert snakes.

Of the pairing of the *harwhal* nothing is known, they are always seen single. The female is similarly coloured to the male, that is with straw coloured belly, and back of a greenish-grey ground with darker mottling. The belly of the male I have noticed has a pinkish tinge in early summer. The female is slightly smaller.

It is said not to hibernate, and as a fact is seen much more frequently in winter all day long than in summer when it is seen in early morning and late evening only. It apparently objects to more than moderate heat and this is borne out by its behaviour in captivity. At night and when not directly under the sun's rays it lay contentedly in the centre of its cage, but when the sun shone directly upon it, great unrest was evinced and it was not happy until a crack or cranny had been found into which at least its head might be pushed.

It is not venomous. I have been bitten and so has my spaniel. There was a very small puncture, little blood and no subsequent reaction of any sort. It is not eaten by the Arab.

The eggs are laid in the burrow chamber and number fifteen to thirty. They are described as being of the size of a pigeon's egg and are white spotted with brown. The young are similar in colour and appearance to the adult.

Both belly and throat swell when the animal hisses, the maximum of hiss and swelling occur together.

The only folklore obtainable was, that the tribes say that if the teats of goats and ewes are found swollen, the recent pastures are searched and a *harwhal* is invariably found in the vicinity. They say that it hangs on to the teats and drinks the milk. The tribes admit that no teeth marks are ever found. In captivity they do not touch milk.

The 'thub' or Spiny-tailed Lizard (*U. microlepis*) has the head of the ordinary lizard to the eye of the lay observer, but its body is almost as broad as it is long. The tail is relatively short but

tremendously thick and carries fifteen to twenty horny spikes which project backwards and slightly outwards from the main stem. I cannot appreciate its utility ; as a weapon it is absurd, and as a boring instrument if it is true that the ' thub ' burrows head first, it is at the wrong end of the machine.

My informants say that it gets its name from its never moving from the one place. It is found all over the Shamiyah Desert but only where stony outcrops occur and is not found at all in the Gizerah.

Its burrow descends vertically in a medium spiral to a depth of about four feet, a horizontal off-shoot near the surface in the female burrow containing the eggs. The burrows are occupied singly and have one outlet.

Unlike the *harwhal* the ' thub ' eats vegetation but of no particular sort. It also eats crickets and it is generally averred that the female thub watches her eggs hatch not from maternal solicitude but in order to eat them.

They hibernate in December and January and are much slighter in February.

They breed in April and May. The female is said at this season to protrude her rear half from her burrow at the same time slowly waving her tail. This attracts passing males who signify their presence by hissing. Hunters often catch a female thub by approaching gently while she is thus employed and imitating the hiss of the male. The female leaves her hole and is then an easy capture. Coitus is by ventral apposition ; the pair do not associate for a time longer than is necessary for the act. Most males are darkly coloured similar to the *harwhal* but there are some much lighter. All females are light.

The eggs which are white are thirty to forty in number and are compared in size and shape to small dates. They are laid in the female's burrow and as stated previously are hatched for the table. Whether she eats only a proportion or all that cannot escape is unknown. Both reptiles and eggs are eaten by the Arab.

They are not venomous, and ripe old age, longer than man, is said to be their destiny if they escape the desert hunters. The commonest method of catching them is to pour water down their holes when they promptly emerge.

Their throats and bellies distend when they hiss as in the *harwhals.*

NASIRIYAH, IRAQ,
September 9, 1927.

NORMAN L. CORKILL.

XXVIII.—HAMADRYADS IN THE KUMAON TERAI

I saw two hamadryads in my shooting block. Neither of them seriously showed much fight. The first one made off through jungle ; I was within 10 yards of it when first seen.

The second was in my back verandah. I heard a curious swishing noise while having tea at 4.30 p.m. and on looking out of the window saw a huge hamadryad slowly moving along the back verandah. I called up the servants and we threatened it with sticks and it made off rapidly. We threw big stones and one caught it on the back, drawing blood. It reared up about 3 feet or more, expanding its hood, but did not drive home its attack and finally went up a bushy tree 15 feet off the ground. Meanwhile my man brought a shot-gun and I shot it through the head. It measured 13 feet.

I may say that I saw two hamadryads last year in a block in the Siwaliks and neither of them showed fight. One we killed, the other was lying beside a stream when I came on it in the early morning while out after a chital. It swam the stream like greased lightning and disappeared.

AJMER,
July 8, 1927.

W. M. LOGAN HOME,
Major,
4th Bombay Grenadiers.

[While the belief that the Hamadryad will attack human beings with or without provocation is widely current, authentic records of its doing so are extremely rare. In the majority of instances this snake, like others of his kind, seeks safety in flight. EDS.]

XXIX.–MR. SLATER'S DEATH BY SNAKE BITE

Some months back you published in your Journal my letter regarding the above, in which I stated that it was a well-known fact in these parts that the snake which bit Mr. Slater of the Geological Department was a King Cobra or Hamadryad. I gave the facts as stated to me by the Range Forest Officer who was at that time in charge of the Thirthahalli Range in the Shimoga District where this incident took place. In a later issue of the Journal Mr. R. C. Morris of Attikan Estate, Mysore District, contradicted my statement, and said that it was not a King Cobra but a Russel's Viper which bit Mr. Slater and caused his death. I am sorry I was not able to reply to this contradiction earlier as I have only now been able to get authentic confirmation of my previous statement.

MYSORE, S. INDIA,
September 27, 1927.

CHARLES THEOBALD.

[Mr. Theobald forwards us letters received by him from the District Magistrate, Shimoga, the Director, Mysore Geological Department, and the District Forest Officer, Shimoga. Though none of these officials were present at the time of the occurrence they conclude from the reports gathered at the time that the snake which caused Mr. Slater's death was a 'Kalinaga' which according to Mr. Theobald is the local name for Hamadryad. EDS.]

XXX.—A NOTE ON THE GREEN WHIP SNAKE (*DRYOPHIS MYCTERIZANS*) AND YOUNG

(*With a photo*)

A short while ago we received in the Society's office two consignments of this beautiful and perhaps the most graceful of our Indian snakes. Among them were a few gravid females. About two weeks after their arrival one of them presented us with fourteen young, twelve of which are alive and vigorous, one was born dead while the last was expelled still enveloped in the fœtal membrane. They were born during the night of September 5 and were discovered the next morning.

The mother taped 1262·5 mm. and the average length of the young, taken approximately twelve hours after birth, was 345 mm., the longest was 368 mm. and the shortest was 339 mm.

In general colouring they are like the parent except that the longitudinal line on either flank is white instead of yellow. There is a distinct white line over the upperside of the orbit which travels forward along the angle of the snout to the tip. This is apparently a juvenile character as it is not present in the adult specimens. The only yellow marking is a short line running backwards from the base of the orbit to the point where the head is differentiated from the body.



The first slough as is customary with snakes took place soon after birth.



THE RECORD CUBBANY MAHSEER.
Weight 105 lbs.

The specimens were measured four days after and though they had had no food, showed an average length of 361 mm.—an average increase of 16 mm. The longest measured 379 mm. and the shortest 342 mm.

On a former occasion a specimen which I had in captivity gave birth to twenty-three young, seventeen of which were alive and the others born dead. On this occasion also they were born during the night.

It is unfortunate that these snakes cannot be kept for any great length of time in captivity as feeding them is a very difficult matter, and though they endure a long time without food they soon begin to look miserable and emaciated. They would perhaps live if they could be kept in a large cage and given a supply of small birds and mice from time to time.

The accompanying photograph shows a number of these creatures in one of our cages.

BOMBAY NATURAL HISTORY SOCIETY,
6, APOLLO STREET, C. McCANN.
September 13, 1927.

[The mass of snakes shown in the photo were part of two consignments of snakes sent from Hyderabad, (Deccan), to Delhi and intercepted *en route* by the postal authorities who, though they tolerate most things, draw the line at live snakes. The sender collected about 280 of these snakes for despatch through the post from which we may conclude that the green Whip Snake is very common in the neighbourhood of Hyderabad. EDS.]

XXXI.—THE RECORD CUBBANY MASHEER

(*With a plate*)

The mighty Masheer shown in the accompanying plate was taken from the Cubbany River, South India (for which it is a record), on November 6, 1926. It was landed in about 40 minutes using a Hardy 16 ft. split cane Hi-Regain rod, cutty-bunk line of 40 lbs. breaking strain and Alcock's special single hook.

Weight	...	...	...	105 lbs.
Length	...	...	...	5 ft. 4 in.
Girth	...	...	...	3 ft. 2 in.

KIRKEE, G. A. HARE,
August 1, 1927. *Lt.-Col.*

[Col. Hare has very kindly presented the skin of this magnificent fish to the Museum of the Bombay Natural History Sociory. EDS.]

XXXII.—AQUATIC RHYNCHOTA IN THE COLLECTION OF THE AGRICULTURAL COLLEGE, COIMBATORE. S. INDIA

(Published with the permission of the Director of Museums, S.S. and F.M.S.)

Rao Sahib Y. Ramachandra Rao, Acting Government Entomologist, Coimbatore, has very kindly entrusted the collection of aquatic Rhynchota in his care to me for identification. Though there is nothing of outstanding interest among this material, the following list of the species contained in it seems to be worth publishing, as it adds considerably to our knowledge of their geographical distribution. All these species, with the exception of the first, are described by Distant in his volumes in the *Fauna of British India* series.

Family Hydrometridæ

1. **Hydrometra greeni**, Kirk. Coimbatore, 'at light'. (Coll. *Y.K.* December 11, 1914).

According to Bergroth (*Zool. Med.*, i, 2, p. 118, 1915) *H. greeni*, Kirk. is quite distinct from *H. lineatus*, Esch. (described by Distant as *H. vittata*, Stal.), though Distant and others have regarded it as a synonym, his opinion being based chiefly on the male genital segments. A conspicuous character, however, is that the whitish hemelytral vitta is broadly fuscously interrupted about four to six times, while in *H. lineatus* it is only narrowly interrupted behind the middle by two transverse veinlets. As the examples before me are females, I have based my identification mainly on this character. J. R. la Torre-Bueno (*Spolia Zeylanica*, xiii, 2, p. 226, 1925), who does not appear to have noticed Bergroth's work, also regards *H. greeni* as a distinct species, though he does not give very definite reasons for his opinion. *H. greeni* is a common Ceylonese insect.

2. **Gerris anadyomene**, Kirk. College Farm, Coimbatore. (Coll. *St. S.V.*, October 11, 1916).

This is another common Ceylonese species, which may be expected to occur in S. India.

3. **Gerris adelaidis**, Dohrn. Pulney Hill, 5,000–6,000 feet. (Coll. *P. S. Nathan*, May 10, 1917).

The specimen before me agrees exactly with the description given by Distant, the semi lunate basal marking on the head being very characteristic. This species is related to *G. paludum* and *G. spinolæ* and would come in Distant's generic section C. It seems to be a little known form of which further material would be useful.

4. **Onychotrechus vadda**, Dist. Pulney Hill, 5,000-6,000 feet. Coll. (*P. S. Nathan*, May 10, 1917).

5. **Cylindrostethus productus**, Spin. Cauvery Bed, Trichinopoly. (Coll. *P. S. Nathan*, March 20, 1918).

6. **Ptilomera laticaudata**, Hardw. Coimbatore.

7. **Metrocoris stali**. Dohrn. Dodabetta, Nilgiri Hills, 8,000 feet.

Family NEPIDÆ

8. **Laccotrephes ruber,** Linn. Wynad, Malabar ; Ponanosat, Tanjore District.

9. **Laccotrephes griseus,** Fabr. Guindy, Madras (Coll. *Fletcher*, August 17, 1913) ; Coimbatore (Coll. *Fletcher*, May 13, 1913 and November 27, 1913 (Coll. *C. A. S.*. March 27, 1915) ; Yemmiganur, Bellary District (Coll. *C. N.* December 24, 1912) ; Sirugappa, Bellary District (Coll. *D. P.*, November 28, 1912).

10. **Ranatra elongata,** Fabr. Peermade, Travancore (Coll. *R. S. V.* April 21–28, 1918) ; Coimbatore (Coll. *Y. R.*, May 18, 1918).

Family, BELOSTOMATIDÆ

11. **Sphærodema rusticum,** Fabr. Mathimudongudem, Kistna District ; Coimbatore ; Sewage Farm, Madras (Coll. *Fletcher*, August 1913).

12. **Belostoma indicum,** Lep. and Serv. Kinavallore, S. Malabar (Coll. *P. S. Nathan*, June 15, 1918) ; College Farm, Coimbatore.

Family NOTONECTIDÆ

13. **Enithares indica,** Fabr. Coimbatore.

14. **Enithares triungularis,** Guer. Peermade, Travancore (Coll. *Isaac*, April 21–28, 1918).

15. **Anisops sardea,** Herr. Schaff. Coimbatore, ' at light '.

16. **Anisops niveus,** Fabr. Peermade, Travancore (Coll. *Isaac*, April 21–28, 1918).

c/o F.M.S. MUSEUM,
KUALA LUMPUR,
F.M.S.

CEDRIC DOVER.

PROCEEDINGS

Proceedings of the Meeting held on September 27, 1927.

A meeting of Members of the Bombay Natural History Society and their friends took place on Tuesday, September 27, at 6.30 p.m., at the Prince of Wales Museum. Mr. H. A. W. Brent presiding.

New Members

The following 51 members were elected since the last meeting:—Mr. F. C. Petit, Bombay; Mr. Ishwardas Lukhmidas, Bombay; Mr. Lakhmidas G. G. Tejpal, Vile Parle, Bombay; Mr. A. P. Neatham, Bombay; Mr. Hooseinbhoy A. Lalljee, Bombay; Sir R. N. Mookerjee, K.C.I.E., K.C.V.O., Calcutta; Mr. A. W. John, Chittavarrai, S.I.; Mr. S. C. Petit, Bombay; Mr. S. C. Barooah, Assam; The Principal, Deccan College, Poona; Mr. Sultanbhoy Bajeebhoy, Bombay; Mr. A. K. Kothare, Bombay; Mr. H. B. Guzdar, Bombay; Mr. C. H. Phillips, Assam; Mr. E. R. Grant, Washington, U.S.A.; Mr. P. M. Dalal, Bombay; Mr. J. Burke, Bombay; Mr. E. C. Benthall, Calcutta; Sir Onkar Mull Jatia, Kt., O.B.E., Calcutta; The Principal, Maharaja's College, Ernaculam, S.I.; Mr. J. N. R. Mehta, Karachi; Mr. R. G. J. Crisp, Itarsi, C.P.; Mrs. A. J. Leech, Madras; Sir Cowasjee Jehangir (Jr.) Kt., K.C.S.I., C.I.E., Poona; Mr. B. S. N. Cooper, Bombay; The Yuvaraj of Limbdi, Limbdi, Kathinwar; Mr. Kaikhosru N. Chandabhoy, B A., F.A.A., Bombay; Major E. A. Breithaupt, Hyderabad, Deccan; Dr. F. E. Davar, L.D.S., R.C.S., L. M. & S., J. P., Bombay; Mr. Ebrahim Dawood Kazi, Bombay; Mr. C. E. Hewetson, I.F.S., Bombay; The Principal, Mrs. A. V. N. College, Vizagapatam; Mr. A. G. C. Elliott, Kishtwar, Jammu; The Librarian, Osmania University College Library, Hyderabad, Deccan; Mr. D. N. Bahadurji, Bombay; Mr. T. T. Kothavala, Dhulia; Mr. Hoshang N. E. Dinshaw, Karachi; Mr. Fakirjee Cowasjee, Karachi; Mr. A. R. Hughes, Bombay; The Honorary Secretary, Ranikhet Club, Ranikhet, U. P.; Mr. Wm. Harper, Bombay; Mr. Rustomjee D. Dalal, Bombay; Khan Bahadur D. B. Cooper, Satara; The Librarian, Lucknow Military Prison & Detention Barracks Library, Lucknow, U.P.; Raja Sardar Singh Bahadur, Khetri, Rajputana; Mr. Muhu...ad Faiyuz Khan, F.R.G.S., F.Z.S., Agra. U. P.; Mr. C. E. Atwood, ... Mr. C. P. Gouldsbury, Mattupatti, S.I.; Mr. C. P. Wallace, Mr. B. P. Patel, Bombay; Mr. K. C. Dinshaw, J.P., Bombay.

The ... case of a series to illustrate the classification of Indian Birds was exhibited before the gathering.

Sir Reginald Spence read a paper on 'Game Preservation in India' compiled from an enormous amount of material received from members, Forest Officers, Sportsmen and others competent to write on the subject from all over the country.

The paper (since published in the Journal) dealt with the existing methods of preserving game from destruction and suggested ways and means which might be employed with advantage in future. Game animals should, on the whole, be looked upon as the living assets of the country and therefore their development, and preservation should be encouraged by every legitimate means. In ... paper attention was drawn to the various parts of the country which were gradually but steadily being depleted of game and where more stringent methods of control were called for.

This of course cannot be entirely left to the forest officials, generally speaking are more concerned with increasing their forest produce revenue than preserving game which is often injurious to the forest plantations.

After the paper was over, the Chairman introduced Mr. J. E. Barton, of the G. I. P. Railway, who very kindly prefaced the film 'Sport in India' which was subsequently shown, with his experiences with the cameramen and the beasts depicted.

The film was kindly lent by the G. I. P. Railway Publicity Department and was made at Betul, on the G. I. P. line in the C. P. The object was to show the public of Bombay what possibilities there were in the way of Big Game shooting within a twenty-four hours' journey from the City.

The pictures were much appreciated and the Chairman moved a vote of thanks both to the Publicity Department of the G. I. P. Railway and to Mr. Barton for his prefatory remarks.

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NOTICE TO READERS

The editors will be pleased to consider illustrated articles of popular Natural History and Sporting interest dealing with the Indian Empire or the Oriental Region for publication in the *Journal of the Bombay Natural History Society*.

Unfortunately our resources do not permit of payment being made for articles published, but thirty reprints are supplied to the author free of charge.

Illustrations and photographs, where numerous, should be submitted along with the articles for selection, and if possible negatives should be sent to ensure best results in reproduction.

The Society's roll of 1,400 members includes the names of many keen sportsmen and nature lovers who enjoy exceptional opportunities for studying the habits of wild animals and, in some cases, of photographing them in their natural environment. Mr. Champion's pictures of wild elephants and Capt. Bates' charming studies of birds and their nests which have been reproduced in the Journal are instances of what might be accomplished in this respect. There are many persons who have an intimate knowledge of the Indian Jungle and a fund of interesting experiences and reminiscences to draw upon which they will not commit to print, either because they lack the inclination or the time to do so or because they are obsessed with the idea that they do not possess a sufficiently fine literary style. The Journal is not a literary publication. It is a Journal intended for all who are interested in Nature and wild life, and a plain record of observations and experiences, of incidents that have aroused wonder or curiosity in forest or in field, or within the limits of a city's garden or a bungalow will hold interest for its readers and will add something to that store of knowledge of Indian animal life which has been accumulated by members of the Society in the thirty odd volumes of its Journal.

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THE BLACK-NECKED CRANE
Megalornis nigricollis
1/11 Nat. size.

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THE GAME BIRDS OF THE INDIAN EMPIRE

BY

E. C. STUART BAKER, F.Z.S., F.L.S., M.B.O.U., H.F.A.O.U.

VOL. V

THE WADERS AND OTHER SEMI-SPORTING BIRDS

PART VI

(With a coloured plate)

(Continued from page 407 of this Volume)

MEGALORNIS NIGRICOLLIS

The Black-necked Crane

Grus nigricollis Przewalski, Mongd. Tang., ii, p. 135 (1876), (Koko Nur.)

Vernacular names.—*Tung-du, Trung-dung.* (Tibet).

Description.—Lores and crown dull red bare skin, sparsely covered with coarse black hairs; a patch of feathers below and behind the eye white, sometimes extending in a narrow line over the eye; rest of head and neck black; wing-quills dull black; the innermost prolonged secondaries black; inner webs of outer secondaries black or mottled with black and many of the greater coverts over the secondaries more or less black on the inner webs; scapulars sometimes with a little black mottling on their terminal quarters; remainder of plumage pale ashy-grey, the shafts of the feathers of the upper plumage showing as fine darker brown lines; tail dark blackish-grey, tipped and edged paler grey.

Colours of soft parts.—"Iris yellow; bill horny-grey or horny-green, more yellow towards the tip; legs and feet black" (Ludlow.)

Measurements.—Wing 625 to 668 mm.; tail 234 to 947 mm.; tarsus 223 to 252 mm.; culmen 124 to 137 mm.

Distribution.—Ladak, Tibet, Setchuan and Yunnan, where it was procured by Forest.

Nidification.—The Black-necked Cranes' nest and eggs were first discovered by Capt. R. Steen in 1905–6 at the Hramtso Lake in Tibet at an altitude of about 14,700 ft. Later Capt. J. Kennedy, Major F. M. Bailey and others found it breeding in some numbers about various Tibetan lakes and Osmaston also found it breeding in the Ladak Lakes.

The nest varies considerably. Often it is a mere scratching in the ground with a pretence of lining, just a few reeds and rushes forming a bed for the eggs to lie on. At other times a more pretentious nest is made and quite a pile of grass, rushes and other weeds is accumulated having a good depression in the centre for the eggs. The bird breeds on the same ground as the Bar-headed Goose and sometimes its own nest is surrounded by the large down-covered nests of these birds. The eggs are two in number and closely resemble those of the Common Crane except in being much bigger. Most of those I have seen are rather dingy olive-brown or olive-green eggs scantily blotched with dull reddish-brown or purplish-brown with secondary, or underlying, markings of purple grey or reddish-grey. Twelve eggs average 101·2 × 64·1 mm.; maxima **105·0** × 63·4 mm. and 103·2 × **69·1** mm.; minima **96·4** × 64·1 and 39·3 × **59·6** mm.

The breeding season is from the end of May to the first week in July, most eggs being laid between May 25 and June 15.

Habits.—Walton found this crane very wild and difficult to approach in the Gyantse plateau but much more tame round about Lhasa, though it seems equally common in either place. During the breeding season it is constantly found in company with Bar-headed Geese and looks very curious as it stalks about, its black head and neck towering above the very white geese. It keeps entirely to the shores and islands of the lakes and to the wide open plateaus, feeding both on vegetable shoots and on all kinds of insects, small reptiles, etc. Ludlow describes its call as very like that of the Common Crane and its flight is said to be powerful and graceful.

Megalornis leucogeranus

The Great White or Siberian Crane

Grus leucogeranus Pallas, Reise Reich. Rus., ii, p. 714 (1773); (Irtin and Ob Rivers.); Blanf. and Oates, iii, p. 187.

Vernacular names.—Kare Khar. (N. W. P.), *Tunki* (Oudh), *Chini Kulang* (Hansi, Hind.); *Burmuch* (Behar).

Description.—Winglet, primary coverts and primaries black; forehead, fore-crown, face and sides of head bare except for a few white bristles; remaining plumage pure white.

Colours of soft parts.—Naked skin of head reddish; iris bright pale yellow; bill umber brown; legs and feet pale reddish-pink. (Hume).

Measurements.—Wing ♂ 635 to 645 mm.; ♀ 538 to 620 mm.; tail 205 to 218 mm.; tarsus 275 to 285 mm.; culmen 185 to 197 mm.

Young birds have the whole head clothed with white feathers and, according to Hume, have the white plumage tinged with buff.

Distribution.—South-eastern Europe, Asia Minor, through Siberia to Japan. In winter migrating to India and North China.

Nidification.—There is very little known of the breeding of this fine crane. It is said by Godlewski to be the most wary and shy of all cranes, inhabiting the steppes near the large rivers, arriving at its breeding haunts in April and leaving again in September. Dresser gives the following as known breeding places. Russia on the lower Ural and in the Perm Government (both uncommon); in the Tolol and Targai Governments, not uncommon; in the northern parts of Turkestan; Dauria on the Vilnui River; in the delta of the Kolzma; Amur, Ussuri to N. E. Mongolia. As regards its nest the only note I have is from Kuschel who in sending a pair of eggs, writes, "I have another pair, both taken by a Russian collector from nests of rushes and reeds on the ground by a lake." The two eggs sent me measure 98·9 × 54·6 and 95·0 × 62·0 m. In colour these have a rather bright reddish-olive ground, well blotched with dark brown primary and purple-grey secondary markings. They can be matched by many eggs of the Common Crane. An egg received by Dresser from Bianchi was paler than most eggs of that bird, but unusually heavily blotched, whilst another laid in Lord Lilford's grounds was a darker colour than most. These two eggs measured 92·7 × 61·7 and 101·3 × 63·2 mm. Other eggs laid in the aviaries of Mr. St. Quentin seem to closely resemble these. Finally, a pair of these eggs from Bianchi was also once exhibited by Dresser at a meeting of the B. O. C.[1] but not described or measured.

June seems to be the month when most eggs are laid, whilst two seems to be the normal clutch. As, however, with many other cranes, often only one young survives and Hume noted that the old birds on arrival in India usually had only *one* young one with them.

Habits.—The Siberian Crane arrives in North-west India about the middle of October, sometimes a little earlier, sometimes not until the third week of that month. Further south they appear still later, not reaching their extreme southern limits until the last week in October or even early November. It regularly visits most parts of North-west India and spreads in lessening numbers as far as the Najafgurh Swamp near Delhi on the south to Jainagar in Behar on the east (where it was seen by Inglis) and to Kohee, twenty miles south-east of Kamptee near Nagpur. Nowhere does it arrive in vast multitudes like the Common and Demoiselle Cranes but only in small flocks seldom numbering more than twenty individuals and often consisting of one or two pairs and their young ones.

This Crane is said to be the most elegant and graceful of all our cranes. Hume says of it, "It is the lily of birds and stand in what position it may, the entire outline of its form presents the most graceful and harmonious curves."

It is exceedingly wary and shy and the utmost patience and care are required for a successful stalk. Moreover the birds keep

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[1] *Bull. B. O. C.*, vol. xxi, p. 53.

entirely, or almost so, to places where there are no facilities for stalking. They stand or wade all day long in shallow swamps or lakes well away from cover and if there are beds of tall reeds and rushes round the edge of these same pieces of water, be sure the birds will be nowhere near them. Hume, who tried all kinds of ways to get within shot says there is but one way of doing so. "You obtain from one of the local fowlers a trained buffalo, and enter the water a good quarter of a mile away from the bird, under cover of this quadruped. It has, as usual, a string run through the nostrils and tied lightly together behind the horns. You hold this string where it lies across the cheek with the left hand; your extended left arm is hidden behind the neck; your whole body is bent, so that your head and shoulders are covered by the buffalo's shoulders, your body and the greater part of your legs, by its body. Only your legs to a little above the knees show close to the hind legs; and, as far as possible, you always keep the beast up to his belly in water. Thus covered you slowly sidle up to the Cranes, making the buffalo, now put his nose up, head in air, now stop and lower his head to the water, and generally dawdle and meander about without apparently any fixed idea in his head, accordingly to the natural manner and customs of a free and independant buffalo. With a little practice it is easy thus to get within shot. You softly let the cheek strings go and at once fire below the buffalo's neck. Before your gun is well off, your sporting companion, who has a marked distrust of Europeans and white faces, and has been incessantly endeavouring to kick you throughout your whole promenade, knocks you head over heels, and rushes off towards his dusky owner, bellowing as if he, and not you, were the injured party."

When not killed outright it defends itself stoutly with legs, wings and bill,but chiefly with the latter, against either human or other foes.

They feed principally on aquatic plants and seldom resort to cultivated dry plains, at all events during their stay in India, nor have the remains of any animals or insects been found in their stomachs. Hume remarks on the remarkable number of small pebbles often found in the stomachs of these birds. Out of an old male he took enough to nearly fill a wine glass, the pebbles being mostly quartz or green stone ranging in size from a pin's head to an ordinary pea.

Their flight is similar to that of the ordinary crane and though they seldom soar, they do so occasionally with ease and grace. Apparently they have no trumpet call like most cranes and their cry has been likened to a repetition of the syllables *karekhur* rapidly repeated whilst their usual note when feeding and undisturbed is a feeble chirrup.

Megalornis monachus

The Hooded Crane

Grus monacha Temm., Pl. Col., pl. 555 (1835) (Yesso and Korea).

Vernacular names.—None recorded.

Description.—Lores, forehead and fore crown covered with black bristles; remainder of head and neck pure white; all the rest of the

plumage dark slaty-grey, more or less tinged with brown, especially on the upper parts ; edges of the feathers both above and below fringed with grey, these almost disappearing in abraded plumage ; quills, the decomposed ends of the drooping secondaries and the tail blackish-brown.

Colours of soft parts.—" Iris yellow ; bill greenish tinged with red towards the base ; feet dull reddish " (Blyth).

Measurements.—Wing 510 to 545 mm. ; tail 155 to 180 mm. ; tarsus 208 to 220 mm. ; culmen 92 to 110 mm.

Young birds appear to be a much paler grey ; the head is well covered with bristly feathers, grey with black shafts on the crown, whiter on the forehead and black on the lores and in a patch on either side of the forehead.

Distribution.—Breeding in Japan and Eastern Siberia, migrating south to China in winter. The only quite certain record of this crane's occurrence in India is that of a young bird shot by me in North Cachar in December, 1899, but I saw several of these cranes on two occasions in the lower reaches of the Subansiri in N. Lakhimpur. Hume saw a small flock of cranes in Manipur which must have been this species and other probable occurrences are recorded by Anderson at Ponsee, west of Bhamo, and by Couchman near Myothil in Upper Burma.

Nidification.—I can find nothing on record beyond the statement that it undoubtedly breeds in Dauria, Amur and in Eastern Siberia and that it arrives in its breeding haunts in April and leaves again in August.

Habits.—This crane is said to haunt open plains and marshes but to be nowhere very numerous, whilst even when migrating it collects in small parties only. According to David and Oustalet it migrates in pairs or in flocks of half a dozen to a dozen. The flock I saw in Cachar numbered seven, and those I saw on the Subansiri were in two flocks of seven and eight respectively. In each of these instances the birds were on the move and though I shot one in Cachar I could get nowhere near those on the Subansiri, though I spent a whole day trying to get at one flock which kept moving down stream and settling every half mile or so. The other flock rose when first disturbed and went right away at once, flying very high in a line and loudly trumpeting at the start. The flock I saw in Cachar seemed very tired as if they had flown far. They pitched very headlong on the banks of the stream I was boating down and stood still as if exhausted. Even after I had shot and secured one, the remaining six kept pitching among the short reeds on the river side, though they would not allow me to get within a hundred yards. Their call seemed to me much like that of the Common Crane and their flight also very similar. They rose with perfect ease from the ground and at once rose to a considerable height.

David and Oustalet comment on the affection shown by a pair of these birds, the one for the other, and narrate how the male of one pair being shot, the female descended to the ground and attempted to assist him to rise.

(*To be continued.*)

REVISION OF
THE FLORA OF THE BOMBAY PRESIDENCY

BY

E. BLATTER, S.J., PH.D., F.L.S.

PART VI

GRAMINEÆ

BY

E. BLATTER and C. MCCANN

(*Continued from p. 435 of this Volume*)

38. HETEROPOGON, Pers. ; Stapf in Prain Fl. Trop. Afr. ix, 410.

Perennial or annual grasses, with simple or more often upwards branched culms ; branches few to many, mostly flowering and gathered into a spatheate panicle ; racemes conspicuously dorsiventral, the bases of the male (or neuter) spikelets subimbricate on the back of the raceme, their upper parts bending forward around the sides, forming a hollow in which the fertile spikelets are enclosed, with their awns exserted anticously and often intertwisted. Spikelets 2-nate, those of the lower (1 to many) pairs alike in sex and shape, male or neuter, of the upper pairs differing in sex and shape, one of each pair sessile, the other pedicelled on the many-jointed rhachis of solitary racemes, terminating the culms and their upper branches ; rhachis, tough or upwards tardily disarticulating and glabrous between the homogamous pairs, readily disarticulating above them ; homogamous pairs long-persistent, the spikelets of the heterogamous pairs falling separately, the pedicelled with the pedicel, the sessile with the adjacent joint and the adjacent pedicel or its base. Sessile spikelets subcylindric, awned ; callus long, pungent, densely bearded upwards. Involucral glumes equal, the lower coriaceous rarely chartaceous, more or less tightly involute, quite keelless, nerves obscure, often connected by few transverse nerves in the upper part ; upper with a deep longitudinal groove on each side, coriaceous, rarely chartaceous, between them, thinner towards the margins, membranous at the tips, 3-nerved. Lower floral glume hyaline, nerveless, upper stipitiform from a hyaline very slender base, cartilaginous upwards and passing into a usually stout geniculate awn. Pale small or absent. Lodicules large or more or less reduced, to very minute. Stamens 3, often rudimentary or absent. Stigmas exserted terminally or laterally. Grain more or less linear in outline, subterete, slightly dorsally compressed ; embryo somewhat exceeding the middle of the grain. Pedicelled spikelets male or neuter, dorsally flattened, usually slightly asymmetric, and often somewhat twisted, muticous, imbricate. Lower involucral glume herbaceous, many-nerved, winged upwards from one or both keels ; upper membranous, lanceolate-oblong, acute, 3-nerved. Floral glumes hyaline, 1-nerved, well developed or more or less reduced. Stamens 3 or 0.

Species about 6, in the tropical and subtropical regions of the whole world.

Cke. describes four species under *Andropogon*, viz. *A. polystachyos*, Roxb., *A. triticeus*, R. Br., *A. Ritchiei*, Hook. f., and *A. contortus*, Linn. We transfer these to *Heteropogon* and add *Heteropogon oliganthus*, Blatter & McCann.

A. Not more than 30 cm. high

I. Upper involucral glume of pedicelled spikelet 1–3-nerved ... ... 1. *H. oliganthus*.

II. Upper involucral glume of pedicelled spikelet 5-nerved ... ... 2. *H. polystachyos*.

B. More than 40 cm. high
  I. Lower involucral glume dorsally deeply grooved ... ... 3. *H. insignis.*
  II. Lower involucral glume not dorsally grooved
    1. Ligule of several narrow membranous segments ... ... 4. *H. Ritchiei.*
    2. Ligule truncate, ciliolate ... ... 5. *H. contortus.*

1. **Heteropogon oliganthus**, Blatter & McCann, *nov. comb.*—*Andropogon oliganthus*, Hochst. ex Steud. Syn. Gram. 368 ; Hook. f. in F.B.I. vii, 201.

Description: A dwarf annual. Stems 7-15 cm. high, tufted, slender, sometimes creeping below, geniculate. Leaves 5-7·5 cm. long, quite flat, subensiform, acuminate, softly hairy, margins thickened, cartilaginous, sheaths compressed ; ligule very short, membranous. Spikes usually very shortly exserted from the long, narrow, glabrous spathes ; peduncle curved, puberulous. Spikes 8-16 mm. long, with 3-6 pairs of glumes, lower spikelets neuter. Joints and pedicels about half as long as the sessile spikelet, long-ciliate. Sessile spikelet 5 mm. long, oblong ; callus short, obtuse. Lower involucral glume obtuse, chartaceous, dorsally villous toward the base, not dorsally channelled, shining, faintly nerved, with narrowly involute margins, ciliolate towards the truncate tip, callus bearded, upper involucral glume obtuse, apiculate. Lower floral glume very short, broadly oblong, ciliate, upper with a shining awn 3-4 cm. long, column of awn glabrous. Pale very small. Anthers 1 mm. long. Pedicelled spikelet, neuter, larger than the sessile, ovate-oblong. Lower involucral glume herbaceous, obovate-oblong, truncate, distinctly 9-13-nerved, subemarginate, keels scabrous, margins ciliolate, hardly incurved, upper shorter by $\frac{1}{5}$, membranous, oblong, obtuse, 1-3-nerved, ciliate. Pale of upper floral glume very small.

Hackel, l.c., is of opinion that this species is intermediate between *Dichanthium* and *Heteropogon*, but comes nearer the *Heteropogons*, because the sessile spikelets differ from the pedicelled ones in shape, nervation and the dorsal furrow.

Locality: *Deccan*: Kalsubai (Patwardhan !) ; Mahableshwar, open edge above the precipices looking from Dhobi's Waterfall path to Elphinstone Point, elevation 4,500 ft., rainfall 270 inches (Sedgwick & Bell 4608 !) ; Panchgani (Blatter & Hallberg B1221 !, McCann !).

Distribution: Nilgiris.

2. **Heteropogon polystachyos**, Blatter & McCann. *comb. nov.*—*Andropogon polystachyos*, Roxb. Fl. Ind. i (1832), 261 ; Steud. Syn. Gram. 367 ; Hook. f. in F.B.I. vii, 989 ; Dalz. and Gibs. 301 ; Cke. ii, 989.—*A. pumilus*, Roxb. Ic. ined. t. 2021 (ex Hook. f.).

Description: Cke. l.c.

Locality: *Deccan*: Khandala (Woodrow) ; Mahableshwar, western side of hill (Dalzell & Gibson). We have not seen this species.

Distribution: Peninsular India.

3. **Heteropogon insignis**, Thw. Enum. Pl. Zeyl. 437 ; Benth. Fl. Austral. vii. 517.—*Andropogon triticeus*, R. Br. Prodr. (1810), 201 ; Hack. Monogr. Androp, 588 ; Steud. Syn. Gram. 368 ; Hook. f. in F.B.I. vii, 200 ; Cke. ii, 989.—*A. ischynanthus et liananthus*, Steud. l.c. 367.

Description: Cke. l.c.

Locality: *Konkan*: Above Kenery Caves (McCann 9634 !).—*Deccan*: Around Vital Hills, Poona (Bhide 782 !) ; Chattarshinji Hill, Poona (Ezekiel !) ; Khandala, very common on open hillside composed of rock fragments (McCann 9425 !) ; Igatpuri (McCann 4338 !) ; Mawal, Poona District (Woodrow).—*S. M. Country*: Manoli (Talbot 3978 !).—*Kanara*: Anmod, bare hillsides, elevation 2,000 ft., rainfall 200 inches (Sedgwick 3324 !).

Distribution: India (Burma, C. Provinces, W. Peninsula), Ceylon, Malaya, Australia.

4. **Heteropogon Ritchiei**, Blatter & McCann, *comb. nov.*-*Andropogon Ritchiei*, Hook. f. in F.B.I. vii, 201 ; Cke. ii, 990.

Description: Cke. l. c.

Locality : *Deccan* : Katraj Ghat, eleven miles S.E. of Poona (Gammie 1037 !) ; hills near Poona (Woodrow).—*S. M. Country* : Belgaum (Ritchie *teste* Hook. f.).

Distribution : W. Peninsula, apparently endemic.

5. **Heteropogon contortus**, Roem. & Schult. Syst. Veg. ii, 836 ; Stapf in Prain ; Fl. Trop. Afr. ix, 411.—*Andropogon contortus*, Linn. Sp. Pl. (1753), 1045 ; Hack. Monogr. Androp. 585 (*excl. A. polystachyus*, Roxb.) ; Hook. f. in F.B.I. vii, 199 ; Cke. ii, 990. For other synonyms see Hook. f. and Stapf l.l. cc.

Vern. Names :—Sunkhali, Nani Sunkhali (Dohad) ; Survalu (Charodi) ; Kursali (Poona) ; Kusal, Sukhli kursali, Ganjali hullu (Belgaum) (ex Burns). Known to Anglo-Indians as Spear grass.

Description : Cke. l. c.

Locality : *Gujarat* : Sevalia (Chibber !) ; road to Lasandra (Chibber !) ; Sungiri (Gammie 15586 !) ; Junagad Kathiawar (Blatter 3789 !). — *Khandesh* : Bhusawal (Gammie !) ; Toranmal (McCann 9640 !).—*Konkan* : Dahe forests (Ryan 717 !) ; Osarvira forest, Mokhada range (Ryan 190 !) ; Malabar hill (McCann 3620 !) ; Mulgaum (McCann 4245 !) ; Parsik, railway line (McCann 9655 !) ; above Kenery Caves (McCann 9662 !).—*Deccan* : Katraj Ghat, 11 miles S. E. of Poona (Shevade !) ; Trimbak (Chibber !) ; Khandala, very common all over the hills (McCann 9422 !) ; Bairawadi, Purandhar (McCann 5059 !) ; Rahuri (Nana A264 !) ; Chattarshinji Hill, Poona (Ezekiel !); Manmad, river bed (Blatter A269 !) ; Igatpuri (McCann 4328 !) ; Panchgani (Blatter & Hallberg B1246 !, B1296 !, B1308 !).—*S.M.Country* : Dharwar, elevation 2,400 ft., rainfall 34 inches (Sedgwick 1820 !) ; Castle Rock (Gammie 15686 !) ; Badami (Talbot 2925 !).—*Kanara* : Yellapore (Talbot 734 !).

Distribution : Mediterranean region and tropics and subtropics generally.

Uses : For an interesting account of this grass see W. Burns; L. B. Kulkarni and S. R. Godbole : A study of some Indian Grasses and Grasslands, in *Mem. Dept. Agr. India* xiv (1925), 28–44.

Varieties : Hackel (l.c.)distinguishes two varieties and,excluding *polystachyus*, 5 subvarieties. His first variety *genuinus* is characterized by the male spikelets being more or less covered on the back or at least above or towards the margins with white, patent tubercle-based bristles. This character together with the degree of ramification of the culms forms the foundation of four subvarieties : *typicus*, *Roxburghii*, *hispidissimus* and *secundus*.

The second variety *glaber* has the male spikelets glabrous. Both varieties are represented in India, and all the subvarieties except *secundus*.

To Hooker f. (l. c.) these varieties and subvarieties appear ' to be too inconstant for definition ', and, according to Stapf (l.c.) the inconstancy of those characters ' is so evident that it is not worth while to discriminate between the forms corresponding to them.' Haines, too, has abstained from distinguishing varieties and forms.

Burns and others in the paper quoted above (p. 40) wrote in 1925 : ' In our observations at Kalas and elsewhere we noticed variability within the species, and early came to the conclusion that there must be definite varieties of *Andropogon contortus*. We can say with confidence that there are at least two varieties, differing markedly in size, habit, longevity, and in morphological characters. One is small and annual, the other large and perennial.' Since then Patwardhan and Hedge have published a paper[1] in which they describe in detail the morphology, anatomy, physiology and ecology of the two varieties. As the authors themselves identify their perennial variety with Hackel's subvariety *typicus*, and their annual variety with Hackel's *hispidissimus*, we shall refer to them in the following under Hackel's names. The description is taken entirely from the paper just mentioned.

Key to the varieties.

1. Lower involucral glume of pedicelled spikelet sparsely hairy with long tubercle-based deciduous hairs on the back, in the upper part and towards the margins ; lower part glabrous ... (*a*) var *genuinus*, subv. *typicus*.

[1] G. B. Patwardhan and G. R. Hedge, Two varieties of *Andropogon contortus*, Linn. In Journ. Ind. Bot. Soc., vi (1927) 213.

2. Lower involucral glume of pedicelled spikelet densely hairy with tubercle-based persistent hairs all over the back; hairs in lower part shorter than in upper ... ... (*b*) var. *genuinus*, subv. *hispidissimus*.

(*a*) **var. genuinus, subv. typicus,** Patwardhan and Hedge l. c.; Hack. in Monogr. Androp. 586 (*sub Androp.*).

Description: Perennial. Stems densely tufted, 45 cm. to 1·2 m., suberect or decumbent, about 3 mm. thick at the base and much flattened, glabrous, simple or subfastigiately branched from the nodes of the upper half; internodes not much longer than the leaf-sheaths. Leaves crowded at the base; sheaths smooth, compressed, keeled, shortly auricled at the mouth; ligule short, truncate, ciliolate; lamina 5–35 cm. long, acuminate or abruptly so, at first folded inward, afterwards flat, rigid, suberect, ciliolate or sparingly hairy on the upper surface, with tubercle-based hairs towards the base, rough to the touch on both surfaces. In semi-dry or dry specimens the leaves may be vinaceous to deep vinaceous in colour. Spike solitary, terminal, 2·5–7·5 cm. long excluding the awn, with closely imbricating pairs of sessile and pedicelled spikelets. Spikelets subsecund, pedicelled ones all male or neuter; of the sessile spikelets the lower 2 to 8 male or neuter awnless, the upper awned, female; the lower awnless spikelets persistent, the upper awned ones deciduous. Sessile spikelet: Lower involucral glume narrow, linear-oblong, truncate or rounded, brownish, many-nerved, hispid with short sparse hairs, margin incurved, tip membranous; upper involucral glume linear, obtuse, coriaceous, dark brown, hispidulous, 3-nerved, margins incurved. Lower floral glume oblong, hyaline, thin, nerveless, short, truncate, paleate; upper empty, reduced to an awn about 7·5 cm. long, column slightly hairy, callus long, pointed, with a tuft of reddish brown hairs. Ovary linear, stigmatic branches from 6–8 mm. long, with thick-set hairs, carmine in colour, fading towards the tips. Pedicelled spikelet: Lower involucral glume lanceolate, obliquely twisted, sparsely hairy with long, tubercle-based, deciduous hairs on the back in the upper part and towards the margins, lower part glabrous, margins unequally winged; upper involucral glume oblong-lanceolate, acuminate, 5-nerved, ciliate towards the tip, margins hyaline. Lower floral glume oblong-hyaline, 1-nerved, ciliate, epaleate, containing stamens; upper empty, obovate, lanceolate, hyaline, ciliate, nerveless. Stamens 3, filaments 3 mm. long; anthers oblong-lanceolate, cordate at base, pale yellow when young, light purplish vinaceous; pollen grains round, not sculptured, dull grey. The sessile male spikelets in the lower part are similar to the pedicelled spikelets above. Fruit 5–8 mm. long, thinly hispid, dark brown with 2 deep furrows on the ventral side, armed with a pointed callus below and a long lash-like awn above.

Locality: Tegur (ex Burns and others).

Distribution: Tropics and subtropics generally, N. W. Himalaya, Afghanistan (ex Hackel).

(*b*) **var. genuinus, subv. hispidissimus.** Patwardhan and Hedge l.c.; Hack. in Monogr. Androp. 587 (*sub Androp.*).—*Andropogon hispidissimus*, Hochstett. in Schimper Pl. Abyss. un. it. no. 1219.—*A. besukiensis*, Steud. in Zoll. Syst. Verz. 59.

Description: Annual. Stems little tufted, 15–60 cm. high, erect or slightly decumbent below, slender and slightly compressed near the base, glabrous, simple or subfastigiately branched from the upper 2 or 3 nodes; internodes much longer than the leaf-sheaths. Leaves little crowded at the base; sheaths smooth, slightly keeled, shortly auricled at the mouth; ligule short, truncate and ciliolate; lamina 2·5–20 cm. by 2·5–5 mm. wide, linear, acuminate or abruptly so, ciliate or hairy on the upper surface up to nearly half its length from the base with tubercle-based hairs, rough to the touch on both surfaces, in semi-dry or dry specimens straw to very light purple in colour. Spike solitary, terminal, 1–5 cm. long excluding the awns, with closely imbricating pairs of sessile (lower) and pedicelled spikelets. Spikelets subsecund, pedicelled, all male or neuter; of sessile the lower 2–5 male or neuter, awnless, upper 4–12 female, awned. Those which are male or neuter persistent, the upper 4–12 pairs which include both males and females deciduous. Sessile spikelet: Lower involucral glume narrow, linear-oblong, truncate or rounded, brownish,

many-nerved, densely hairy with whitish long hairs, margins incurved, tips membranous ; upper involucral glume linear, obtuse, coriaceous, dark brown, hispidulous, 3-nerved with incurved margins. Lower floral glume oblong, hyaline, thin, nerveless, short, truncate, epaleate, upper empty, reduced to an awn, 5·1 cm. long, column densely hairy with whitish hairs, callus long, pointed, bearded with light brown hairs. Ovary linear, stigmatic branches 4–5 mm. long with thinly set ox-blood red hairs. Pedicelled spikelet : Lower involucral glume lanceolate, obliquely twisted, densely hairy with tubercle-based, persistent hairs all over the back, hairs on lower part shorter than in upper ; upper involucral glume oblong-lanceolate, acuminate, 5-nerved, ciliate, tip hairy, margins hyaline. Lower floral glume oblong, hyaline, 1-nerved, ciliate, upper oblong or obovate-lanceolate, hyaline, nerveless. Stamens 3, filaments 4 mm. long ; anthers oblong, sagitate, pale yellow when young, sulphur yellow when mature ; pollen grains round, smooth, dull grey. The sessile spikelets in the lower part are similar to the pedicelled spikelets above. Fruit 5–8 mm. long, densely hairy with whitish soft hairs, light brown with two deep furrows on the ventral side, armed with a pointed callus below and a long, lash-like awn above.

Locality : ' Usually found on the very shallow parts of Deccan soils ' (ex Burns and others, l. c.).

Distribution : Malabar, tropical Africa, Madagascar, Java, Phillippines.

39. Iseilema, Hack. ; Cke. ii, 995.

Cke. has described two species : *I. Wightii*, Anders. and *I. laxum*, Hack. We add a third one, *I. anthephoroides*, Hack.

The following key is after Hole[1] :—

A. Lower involucral glume of hermaphrodite spikelet dorsally appressed, hairy at base and ciliate on margins in basal ¼ ... 1. *I. anthephoroides.*

B. Lower involucral glume of hermaphrodite spikelet glabrous dorsally at base and on margins in basal ¼.

I. Spathe and upper floral leaf not tubercled on keel ... 2. *I. laxum.*

II. Spathe and upper floral leaf tubercled on keel ... 3. *I. Wightii.*

1. Iseilema anthephoroides, Hack. Monogr. Androp. 683 ; Hook. f. in. F.B.I. vii, 219 ; Haines Bot. Bihar & Orissa, 1054.

Description : A much tufted annual grass, very leafy below, with many stems 30–80 cm. high, sometimes pink, nodes glabrous. Leaves mostly short, the longer ones about 13 cm. by 5 mm., subobtuse, ciliate at base and tip of sheaths, cilia with small tubercle-bases, blades with scabrid margins, nerves usually fine and uniform ; ligule of short fine hairs. Panicles long, rather strict, but some of the spatheoles divergent, lower spathes foliaceous, upper with shorter blades, base of blade and top of sheath with very long cilia ; spathes often with many tubercles on the margins. Spatheoles cymbiform, not acuminate, smooth and glabrous or minutely tubercled and scaberulous, margins scarious, several spatheoles from each spathe or leaf-sheath. Peduncle of cluster very short, 2·5–5 mm. long. Cluster scantily bearded at the base. Involucral spikelets broadly oblong, 4 mm. long, rounded at tip, not or very sparsely ciliate, their pedicels about 1 mm. long and nearly as broad at top, compressed, bearded. Glumes 2 only. Lower involucral glume with narrowly inflexed margins, strongly 2-nerved on the back and almost sulcate on either side of midrib, 2 other partial nerves between the strong ones, upper involucral glume nearly as long, flat, oblong, obtuse, 1-nerved ; floral glume absent. Anthers yellow. Sessile spikelet 5–6 mm. long, suddenly tapering part or beak rather longer than the lower broader part. Lower involucral glume 2-cuspidate at tip, 4-nerved between keels, hispid-hairy on the back on the wider portion, the beak scabrid or scabrellous ; upper involucral glume as long,

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[1] R. S. Hole, The Indian Species of *Iseilema*, Agric. Journ. of India, Special Ind. Sc. Congress Number (1917), 125–131. See also A. Camus, Le genre *Iseilema*, in Bull. Soc. Bot. France, series 4, xxiii (1923), 493.

narrowly lanceolate with prominent ciliate keel on lower third, scabrellous above, margin inflexed. Lower floral glume very narrow, 2-nerved, ciliate, upper reduced to the membranous base of the awn, awn 12-14 mm. long, very slender, nearly smooth.

Locality: *Khandesh*: Near Naradana (Blatter & Hallberg 5206!) — *Deccan*: Katraj Ghat (Gammie 929!); Deolali (Blatter & Hallberg A316!); Chattarshinji Hill, Poona (Ezekiel!); Pashan (Gammie!).—*S. M. Country*: Black soil fields E. of Hubli (Sedgwick & Bell 5295!); Yelvigi (Sedgwick 2085!).

Distribution: W. India and Deccan.

Uses: A smaller yielder and an inferior fodder plant than *I. laxum*. See W. Burns Bull. 78, Dept. Agric. Bombay, p. 11.

2. **Iseilema laxum**, Hack. Monogr. Androp. 682; Hook. f. F.B.I. vii, 218; Cke. ii, 996. For synonyms see Hook. f. l. c

Description: Cke. l. c.

Locality: *Gujarat*: Red upland near Talod (Sedgwick!).—*Khandesh*: Bor, Bori River (Blatter & Hallberg 4429!); Toner, Tapti bank (Blatter & Hallberg 5167!); Dadgaum (McCann A322!).—*Konkan*: Sion (McCann 3068!); Thana (McCann 8728!); Parsik Hill (McCann A321!); Bhandup, rice field (McCann A323!); Trombay (McCann A324!).—*Deccan*: Grasslands between Mahableshwar and Panchgani (Sedgwick & Bell 4742!); Nasik (Bourke!); Lohagad, half way up (McCann A320!); Poona (Jacquemont 439).—*S. M. Country*: Dastikop (Sedgwick 2059!); Dharwar (Sedgwick 1826!); Belgaum (Ritchie 799).—*Kanara*: Halyal (Talbot 2087!); Sirsi (Kulkarni!).

Distribution: Upper Gangetic Plain, Orissa, Deccan, W. Peninsula.

Uses: Considered to be the best fodder grass in Central and S. India.

3. **Iseilema Wightii**, Anders. in Nov. Act. Soc. Sc. Upsala ser. 3, 2 (1858), 251; Hack. Monogr. Androp. 679; Hook. f. F. B. I. vii, 218; Cke. ii. 996. For synonyms see Hackel and Hook. f. 11. cc.

Vern. Names: Mabid (Dohad), Moshi (Surat), Gandhi (Charodi), Gandheli (Panch Mahals), Sona, Tambrut, Tambit, Gondval, Gamsi, Mussau (ex Burns).

Description: Cke. l.c.

Locality: *Gujarat*: Kharaghoda (Saxton 503C!); in a very marshy valley between Wastrapur and Thaltij (Sedgwick 322!); Morvi, Kathiawar (Woodrow).—*Khandesh*: Antroli, Bori River (Blatter & Hallberg 5150!).—*Deccan*: Panchgani (Blatter & Hallberg B1294!); Poona (Woodrow).—*S. M. Country*: Kunnur (Sedgwick & Bell 4922!); Rhanibennur (Bhide!); Haveri (Talbot 2254!); Dharwar (Nana A325!); Belgaum (Woodrow).—*Kanara*: Halyal (Talbot 2143!).

Distribution: Throughout India.

Uses: A fair fodder.

40. Themeda, Forsk.; Cke. ii. 992.

Species about 16, in the tropical and subtropical regions of the Old World, chiefly Indo-Malayan.

Cooke describes 4 species: *T. imberbis*, T. Cooke, *T. ciliata*, Hack., *T. cymbaria*, Hack., and *T. tremula*, Hack. Following the laws of priority we have to substitute for the first two: *T. triandra*, Forsk. and *T. quadrivalvis*, O. Kuntze.

I. Involucral spikelets truly verticillate
  1. Involucral spikelets glabrous or more or less irregularly beset with tubercle-based hairs ... ... 1. *T. triandra*.
  2. Involucral spikelets always with a row of stiff bristles along the flexures near the tips, the bristles arising from coarse pale tubercles ... ... 2. *T. quadrivalvis*.

II. Involucral spikelets in closely superposed pairs
  1. Inflorescence a decompound thyrsiform panicle. Lower involucral glume of bisexual spikelets not channelled ... 3. *T. cymbaria*.

2. Inflorescence a racemiform panicle. Lower involucral glume of bisexual spikelets deeply channelled ... ... 4. *T. tremula*.

1. **Themeda triandra**, Forsk. Fl. Aegypt. Arab. cxxiii *et* 178; Schweinf. in Bull. Herb. Boiss. ii, Append. ii, 16, 95; K. Schum. in Engl. Pfl. Ost.—Afr. A. 51; Rendle in Cat. Afr. Pl. Welw. ii, 161; Pilg. in Engl. Pflanzenw. Afr. ii, 151, fig. 114; Pilg. in Mildbr. Wiss. Ergebn. Deutsch. Zentr.—Afr. Exped. ii, 45; Eyles in Trans. Roy. Soc. S. Afr. v. 298; Stapf in Prain Fl. Trop. Afr. ix, 416, *partem tantum nostræ speciei amplectens.—Themeda Forskalii*, Hack. in Monogr. Androp. 659, *excl. syn. Anthistiria hispida*, Thunb. *quæ est Tristachya leucothrix*, Trin. *sec.* Stapf.; Duthie Fodd. Grass. N. Ind. 43; Durand & Schinz Consp. Fl. Afr. v. 731; K. Schum. l.c. A. 23, 56, 79; Engl. Hochgebirgsfl. Trop. Afr. 115; Batt. & Trab. Fl. Anal. Algér. et Tunis 355; Stapf in Kew Bull. (1907), 212; Pilg. in Engl. Pflanzenw. Afr. ii, 119.—*Anthistiria imberbis*, Retz. Obs. iii, 11; Desf. in Journ. de Phys. xl, 293, t. 1; Thunb. Fl. Cap. i, 402, ed. Schult., 107; Kunth Enum. i, 481; Steud. Syn. Pl. Glum. i, 401; Stapf in Dyer Fl. Cap. vii, 366; Wood Natal Pl. ii, t. 133; Burtt Davy in Transvaal Agric. Journ. iii, 287, t. 52; Hook. f. in F.B.I. vii, 211; Trin. Fl. Ceyl. v, 248; Prain Beng. Pl. 1207.—*A. glauca*, Desf. Fl. Atlant. ii, 380, t. 254 *excl. syn.—Stipa paleacea*, Vahl; Coss. & Durieu Expl. Scient. Algér. ii, 52.—*A. Desfontainei*, Kunth Rev. Gram. i, 161.—*A. ciliata*, Retz. l.c. (*non* Linn. f.); Lamk. Ill. t. 841, f. 2; Cav. Ic. 5, t. 459; Nees in Linnaea vii, 284 *et* in Fl. Afr. Austr. 121; Anders. in Peters Reise Mossamb. Bot. 562; Oliv. in Trans. Linn. Soc., xxix, 176; Roxb. Fl. Ind., i, 247; Grah. Cat. Bomb. Pl. 239; Dalz. & Gibs. Bomb. Fl. 304; Thw. Enum. Pl. Zeyl. 366; Trim. Cat. Ceyl. Pl. 108, Benth. Fl. Austr. vii, 542.—*A. Forskahlii*, Kunth Rev. Gram. i, 162, Enum. Pl. 481.—*A. vulgaris*, Hack. in Engl. & Prantl. Natürl. Pflanzenfam. ii, pars 2, 29.—*A. punctata*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 448.—*A. paleacea*, Ball. in Journ. Linn. Soc. Bot. xvi, 734.—*A. australis*, R. Br. Prodr. 200.—*A. cuspidata*, Anders. in Nov. Act. Upsal. 2 (1856), 229.—*A. cæspitosa*, Anders. l.c. 241.—*A. argentea*, Nees Fl. Afr. Austr. 124.—*A. depauperata*, Anders, l.c. 243.—*A. syriaca*, Boiss. Diagn. Pl. Or. ser. i, fasc. 13, 72.—*Themeda polygama*, Gmel. Syst. 149.—*Stipa arguens*, Thunb. Prodr. 20 (*non* Linn.).—*Calamina imberbis*, Roem. & Schult. Syst. ii, 810.—*Themeda imberbis*, T. Cooke in Cke. ii, 993.—*T. imberbis*, Haines in Bot. Bihar & Orissa, 1049.

Hooker f. who deals with this species under *Anthistiria*, Linn., says in a preliminary remark (F.B.I., vii, 211): 'The species of this genus are most difficult of discrimination, of which the best proof is the irreconcilable conclusions of two excellent botanists, both experts in the order of *Gramineæ*, Anderson (in Nov. Act. Upsal iii, ii (1856)) and Hackel (Monogr. Androp.).'

He then criticizes Hackel for having restored Forskahl's name of *Themeda* 'because of its having four years of priority, and of Linnaeus' description of *Anthistiria* being very inaccurate.' He admits the claim of priority, but as to the other reason he rightly adds that if inaccurate description has to be considered, a host of the genera of old authors would have to be invalidated. Hooker finally decides in favour of *Anthistiria* because this genus 'had for upwards of a century been adopted by all botanical writers.' This reason, however, does not hold good in view of the present rules of nomenclature. Hackel restored *Themeda* in 1889 and since then most systematists have followed his example. It was easy to settle this point, but the real difficulty comes in when we have to define and give a name to all the material gathered by Hackel (l. c. 659–664) under his *Themeda Forskalii*, and by Hooker f. under *Anthistiria imberbis*, Retz. (F.B.I. vii, 211).

A glance at Hackel's synonymy and localities shows that he has included all the forms of this highly variable grass which are found in the tropical, subtropical and sometimes in the temperate regions of the Old World. The same applies to Hooker's *A. imberbis*, except that he separated Hackel's var. *dubia laxa* and restored it to its former specific rank of *A. laxa*, Anders. But this is of minor importance in this connection. It does not change the fact that both Hackel and Hooker describe the same material and of the same area though under different names.

Hackel justifies the adoption of the specific name *Themeda Forskalii* in this way: '*Themeda triandra*, Forsk. Fl. Aeg.-arab. p. 178, *Anthist. Forskalii* Kunth Revis. Gram. 1, p. 162, generis typus, a Forskalio prope Bulgose in

Arabia felici lecta, probabiliter etiam varietas est Th. Forskalii meae ; sed descriptio rem dubiam relinquit, specimina authentica desiderantur. Nec hucusque ullam hujus generis speciem in Arabia felici lectam vidi, etsi probabile est, Th. Forskalii varietates in Syria Abyssiniaque crescentes etiam in Arabia inveniri. Itaque nomen specificum " triandra " tamquam dubium et rem indicans quae in hoc et plerisque Graminearum generibus nullius est momenti, seposui, " Forskalii " a Kunthio datum non minus quidem dubium, sed generis auctorem commemorans recepi.'

Hooker does not agree with Hackel, ' The earliest names of this plant are *Themeda triandra*, Forsk., and *Anthistiria imberbis*, Retz. Hackel has abandoned both, substituting first *Anthistiria vulgaris*, and then *Themeda Forskalii*, on the ground that *A. imberbis* was perhaps not Forskahl's *T. triandra* (why then call it *Forskalii* ?) of which no type specimen exists, and because *triandra* indicates a character of no individual value in grasses. In so doing he overlooked Gmelin's name of T. *polygama* (Syst. 149). Having regard to the wide range of *A. imberbis*, from Australia to Africa, its presence in Arabia might well be anticipated ; and that it is a native of that country is now proved by Schweinfurth's finding Hackel's var. *glauca* in that country. This makes the var. (which is local, and not Indian) the type of the species, and if Forskahl's name of *Themeda* is to be retained, necessitates a re-arrangement of the varieties. To me it appears most expedient to retain Retz.'s name which applies to the prevalent form over the area of distribution as the specific one. '

Hooker's reasons against Hackel's view are certainly valid, but his own *Anthistiria imberbis* does not rest on a firmer foundation. The fact that the var. is local and not Indian should not prevent us from making it the type of the species, and the other circumstance that a re-arrangement of the varieties will become necessary if the name *Themeda* is retained, can only be a reason of expediency.

So far we come to the conclusion that Hackel and Hooker deal with the same material, but that neither name is satisfactory.

We come now to the latest publication affecting our question. Stapf l.c. has adopted the name *Themeda triandra*, Forsk. (1775) instead of *T. Forskalii* (1889), ' as there is no doubt that the type of Forskal's species, which apparently has been lost, was one of the forms covered by the description given by Stapf ' (see Schweinfurth in Bull. Herb. Boiss. ii, App. II, 16).

But here Stapf creates a new difficulty. His description applies only to the ' African share of Hackel's *T. Forskalii* '. In order not to be open to misstatements we quote the whole passage in which Stapf explains his position : ' The species, as defined here, is, however, taken in a sense somewhat narrower than Hackel's ; this restriction requires a short explanation. Hackel in his monograph of the *Andropogoneæ* distinguishes eleven varieties and as many subvarieties or forms within his *T. Forskalii*, whilst other authors have at various times described more than a dozen species, all of which come within the compass. There can be no doubt as to the close affinity of these forms and the question of their status is mainly one of expediency. A careful examination of the large amount of material at Kew and the British Museum has led to the conclusion that for the present it will be most useful to detach, firstly, those forms that are fairly uniform, and at the same time exclusive, over a large area ; and secondly, those that, though of a limited range, stand out from the remainder by some character or characters. This leaves a residuum much less homogeneous than any of the segregates just referred to. It consists apparently of more or less fixed races, mutants, hybrids and edaphic forms which from herberium material are the less separable because they are to a high degree independent of geographical areas. At the same time, however, they are all African with an extension into Arabia, Syria and the south-eastern corner of Asia Minor, and, taken as a whole, represent practically the African share of Hackel's *T. Forskalii*. It is to this aggregate that the description and synonymy given above apply.'

From the above it is evident that Stapf's *T. triandra*, Forsk. is not identical with Hackel's *T. Forskalii* and Hooker's *A. imberbis*, Retz., as it comprises only the African element including ' an extension into Arabia, Syria, and the south-eastern corner of Asia Minor.' Stapf's synonymy leads to the same conclusion, except for the inclusion of *T. imberbis*, T. Cooke (Fl. Bombay ii, 993). The Australian element *Anthistiria australis*, R. Br. has been separated by the same author as *Themeda australis*, Stapf. It seems to us that Stapf's treatment

of *T. Triandra* is somewhat arbitrary. We quite agree that the name should remain and that it is the only correct name, but we cannot agree to its being restricted to the African element only, and it is difficult to understand why the Indian specimen should not go by the same name. If we could distinguish groups of varieties or forms that are confined to more or less definable geographical areas, it would be admissible to speak, e.g. of an African group and call it *T. triandra*, because Arabia exhibits one of those African forms, or of an Indian or Australian group, and name them accordingly. But experience shows that with regard to the material under review there are no such geographical areas which contain a group of varieties or forms that are peculiar to one area exclusively. A glance at the localities given by Hackel under the different varieties and sub-varieties will confirm our statement.

We are, therefore, of opinion that the name *Themeda triandra*, Forsk. should embrace all the material that was described by Hackel under *T. Forskalii*, by Hooker under *A. imberbis*, and by Cooke under *T. imberbis*.

Haines describes the material from Bihar and Orissa under the name of *T. imberbis*, T. Cooke, and adds in brackets 'partly'. His species, therefore, is not Cooke's *T. imberbis*, but must be given some other specific name as long as Cooke's name stands. But if botanists adopt our *T. triandra*, Forsk. Haines' name will be merged in it, and his material may be treated as a form or group of forms under that species.

Description : See Hackel, Hook. f. and Cooke 11. cc.

Locality : *Gujarat* : Ahmedabad (Gammie 16391 !).—*Khandesh* : Toranmal (McCann 9813 !).—*Konkan* : Mokhada range (Ryan 2626 !) ; Mahaluxmi (Sabnis A297 !) ; Bhandup (McCann 9810 !) ; Bassein (McCann 4475 !).—*Deccan* : Ganeshkhind Botanic Gardens (Garade !) ; Panchgani (Blatter 3806 !, Blatter & Hallberg B1326 !) ; Khandala, common (McCann A291 !) ; Bairawadi, Purandhar (McCann 5069 !) ; Igatpuri (McCann 4322 !) ; Poondra (Talbot 4307 !).—*S. M. Country* : Devaranji, elevation 1,800 ft., rainfall 90 inches, (Sedgwick & Bell 4427 !) ; Castle Rock (Gammie 15728 !) ; Dudsagar Falls (McCann A298 !) ; Dharwar (Nana A289 !).

Distribution : Africa, Indo-Malaya, Australia.

2. **Themeda quadrivalvis**, O. Kuntze Rev. Gen. Pl. II, 794 ; Stapf in Prain Fl. Trop. Afr. ix, 420 ; Haines in Bot. Bihar & Orissa 1050.—*Andropogon quadrivalva, err. typog.*, Linn. Syst. ed. 13, 758.—*Themeda ciliata*, Hack. in Monogr. Androp. 664 ; Cke. ii, 994.—*Anthistiria ciliata*, Linn. f. Suppl. 113 ; Gærtn. Fruct. ii, 465. t. 175 ; Lam. Ill. t. 841, fig. 1 ; Beauv. Agrost. t. 23, f. 7 ; Kunth Enum. i, 481 ; Steud. Syn. Pl. Glum. i, 401 ; Baker Fl. Maurit. 448 ; Balf. f. Bot. Socotra 317 (*partim*) ; Duthie Grass. N. W. Ind. 42 ; Hook. f. in F B.I. vii, 213 ; Stapf in Dyer Fl. Cap. vii, 368.—*A. scandens*, Roxb. Fl. Ind. i, 248 ; Duthie Fodd. Gr. N. W. Ind. t. 61.—*A. semiberbis*, Nees. Fl. Afr. Austr. 125.—*Andropogon nutans*, Linn. Mant. ii, 303.

Vern. Names : Bongrut (Sholapur) ; Bhathu (Surat) ; Bhati, Zini bathi, Mothi bathi (Dohad) ; Bhatharu (Broach) (ex Burns).

Description : Cke. l.c.

Locality : Gujarat : Ahmedabad (Gammie 16391 !).—*Khandesh* : Toranmal (McCann 9817 !).—*Konkan* : Parsik, railway line (McCann 9808 !) ; Alibag, water-works (Ezekiel !) ; S. Konkan (Stocks *teste* Cooke, Law) ; Salsette (Jacquemont 717 *teste* Cooke).—*Deccan* : Pashan, near Poona (Gammie !) ; road, Mahableshwar to Pratapgad (Bhide 1170 !) ; Purandhar (McCann 5571 !) ; Bairwadi, Purandhar (McCann 507A !) ; Panchgani (Blatter & Hallberg B1311 !, B1325 !).—*S. M. Country* : Konankeri, elevation 2,000 ft., rainfall 40 inches (Sedgwick & Bell 4943 !) ; Dharwar elevation 2,400 ft., rainfall 34 inches (Sedgwick & Bell 4486 !) ; Dastikop elevation 2,500 ft., rainfall 35 inches (Sedgwick & Bell 2060 !) ; Castle Rock (Gammie 15729 !) ; Belgaum (Ritchie 886 *teste* Cooke).—*Kanara* : Halyal (Talbot 2115 !).

Distribution : N. W. India, Bengal, C. Provinces, W. Peninsula, Tenasserim. Introduced in tropical and S. Africa.

3. **Themeda cymbaria**, Hack. in Monogr. Androp. 668 ; Cke. ii, 994.—*Anthistiria cymbaria*, Roxb. Hort. Beng. (1814), 6, *et* Fl. Ind. i, 251 (*excl. syn.*) ; Kunth Enum. Pl. i, 482 (excl. syn.) ; Grah. Cat. Bomb. Pl. 219 ; Dalz & Gibs. Bomb. Fl. 304 ; Hook. f. in F. B. I. vii, 215 ; Trim. Fl. Ceyl. v, 249.

Description : Cke. l. c.

Locality: *Khandesh*: Dadgaum (McCann 9815!); Toranmal (McCann 9818!).—*Konkan*: common (Cooke); I am doubtful (McCann).—*Deccan*: Lonavla (Garade!).—*S. M. Country*: Castle Rock (Gammie 15634!).—*Kanara*: Mirjan (Hallberg & McCann A295!).

Distribution: W. Peninsula, Ceylon.

4. **Themeda tremula,** Hack. Monogr. Androp. 667; Cke. ii, 995.—*Anthistiria tremula,* Nees ex Steud. Syn. Gram. 401; Hook. f. in F.B.I. vii, 214.—*Andropogon tremula,* Anders. in Nov. Act. Upsal. ser. iii, ii (1856), 247.

Description: Cke. l. c.

Locality: *Konkan*: Trombay (McCann A293!); Ghatkoper, Horse-shoe Valley (McCann A327!).—*Deccan*: Khandala (McCann 5359!); Igatpuri (Blatter & Hallberg 5484!); Purandhar, northern foot (McCann 5041!); Poona (Woodrow *teste* Cooke).—*S. M. Country*: Devaranji, elevation 1,800 ft., rainfall 90 inches (Sedgwick & Bell 4428!); Castle Rock (Gammie 15687!).—*Kanara*: Devimani Ghat (Kulkarni!); Jugglepet (Talbot 1568!); Tinai Ghat (Sedgwick & Bell 3196!); Sirsi to Siddhapur (Hallberg & McCann A294!).

Distribution: From the Central Provinces and the Konkan southwards, Ceylon.

41. Pseudanthistiria, Hook. f.; Cke. ii, 992.

Species 4.—Indian.

Cooke has described one species: *P. hispida,* Hook. f. We add two others: *P. umbellata,* Hook. f. and *P. heteroclita,* Hook. f.

I. Ligule exauriculate
  1. Ligule a truncate glabrous membrane, much divided to the base, the tips minutely ciliolate. Sessile spikelets glabrous ... ... 1. *P. hispida.*
  2. Ligule short, membranous. Sessile spikelets not glabrous ... ... 2. *P. heteroclita.*

II. Ligule auricled ... ... 3. *P. umbellata.*

1. **Pseudanthistiria hispida,** Hook. f. in F. B. I. vii, 219; Cke. ii, 992.

Description: Cke. l.c.

Locality: *Gujarat*: Surat (Garade!).—*Konkan*: Dahe Forest (Ryan 705!); Matheran (D'Almeida A329!); Ghatkoper, Horse-shoe Valley (McCann A326!); Sion (McCann 5247!); St. Xavier's College compound, Bombay (McCann 4524!); Kalyan (Woodrow).—*Deccan*: Lonavla (Gammie!); Purandhar Fort (Gammie 1010!); Igatpuri Ghats (McCann 4343!); Khandala, common, railway line (McCann A331!); Panchgani (Woodrow).—*S. M. Country*: Castle Rock (Gammie 15634, McCann A328!); Derikop (Sedgwick 2061!); Londa (Gammie 15863!, Woodrow).—*Kanara*: Birchy (Talbot 2096!); Yellapore (Talbot 1522!); Devimani Ghat (Kulkarni!).

Distribution: C. Provinces, W. Peninsula.

2. **Pseudanthistiria heteroclita,** Hook. f. in F. B. I. vii, 219.—*Andropogon heteroclitus,* Nees Fl. Afr. Austr. 115; Steud. Syn. Gram. 389; Hack. in Monogr. Androp. 400.—*A. monomeros,* Hochst. in Hohen. Pl. Ind. Or. no. 183.—*Anthistiria heteroclita,* Roxb. Fl. Ind. i. 249.

Description: Stems 30–80 cm. high, geniculate, slender, terete, smooth, subsimple or branched. Leaves linear, 15–30 cm. long, 3–5 mm. broad, glabrous or more or less ciliate on both surfaces, nerves distinct, margins with long, tubercle-based hairs or nearly glabrous; sheaths much shorter than the internodes, quite glabrous; ligule short, membranous, exauriculate. Panicles 20–30 cm. long, leafy, compound, with many shortly peduncled fascicles, fascicles of spikes about 12 mm. broad, proper spathes 7–10 mm. long, hardly longer than the spikes, towards the margin with long, tubercle-based bristles; spikes 6–8 mm. long. Sessile spikelets 3–4 mm. long, linear-oblong, hispidulous all over. Lower involucral glume furrowed. Upper floral glume awned, awn 18–24 mm. long, thin. Pedicelled spikelets lanceolate, with a few long, tubercle-based bristles, keel ciliate.

Locality: Konkan (Law ex Hook. f.).

Distribution: Bengal, Konkan, S. Kanara.

3. **Pseudanthistiria umbellata,** Hook. f. in F. B. I. vii, 220.—*Andropogon umbellatus,* Hack. Monogr. Androp. 401.

Description : A very slender, glabrous plant with filiform, prostrate, creeping branched stems, rooting at the nodes, stems 30-60 cm. long, compressed. Blade 2–5 cm. long, distant, linear-oblong, acute, rounded at base, sessile or short-petioled, nerves distinct, very slender, with a few scattered cilia on both surfaces, nearly smooth ; sheaths shorter than the blade, often with tubercle-based hairs above, rarely glabrous ; ligule passing at the sides into 2 short, herbaceous, fimbriate auricles of the sheath. Panicle leafy, very lax, interrupted, 12-20 cm. long ; fascicles of spikelets few, axillary, 6–12 mm. broad, glabrous or with a few tubercle-based cilia on simple, rarely branched capillary peduncles shorter than the leaves ; lower peduncles sometimes elongate, 2·5–7·5 cm. long and bearing several fascicles ; outer spathes 8-25 mm. long ; spikes 3-6 in a fascicle, proper spathe 10–12 mm. long, rather longer than the spikes, glabrous or towards the margin with a few bulbous-based hairs. Sessile spikelets 3-4·5 mm. long, linear, scaberulous. Lower involucral glume dorsally concave ; awn of upper floral glume 12–14 mm. long, very thin. Pedicelled spikelets linear-lanceolate, naked, awn 12–18 mm. long.

Locality : *S. M. Country* : Londa (Gammie 15869 !).—*Kanara* : Birchy (Talbot 2073 !).

Distribution : Deccan and W. Peninsula, Ceylon.

42. DIGITARIA, Hall. Hist. Stirp. ii (1768), 244 ; Stapf in Prain Fl. Trop. Afr. ix, 422.

Species more than 100, in the warm parts of the whole world, but chiefly in the Old World.

Cke. (ii, 940-942) describes 6 species. All are retained in this place, but the name of *Digitaria sanguinalis* will be replaced by *D. marginata*.

Key as in Cke.

1. **Digitaria ternata**, Stapf in Dyer Fl. Cap. vii, 376, *et* in Prain Fl. Trop. Afr. ix, 452 ; Cke. ii, 940.—*Paspalum ternatum*, Hook. f. in F. B. I. vii, 17.—*Panicum ternatum*, Hochst. in Flora xxiv (1841), 1, Intell. 19 ; Hack. in Oest. Bot. Zeitschr. (1901), 331.—*P. phœnocarpum*, var. *gracile*, Nees Fl. Afr. Austr. 23.—*Cynodon ternatum*, A. Rich. Tent. Fl. Abyss. ii, 405.

Description : Cke. l. c. Occasionally long fine hairs are found on the peduncles.

Locality : *Deccan* : Purandhar Fort (Bhide !).—*S. M. Country* : Belgaum (Herb. Bot. Gard. Cal.).

Distribution : India (Khasia Hills, Burma, W. Peninsula), Yunnan, tropical and S. Africa.

2. **Digitaria marginata**, Link Hort. Berol. i, 229 ; Stapf in Prain Fl. Trop. Afr. ix, 439.

Description : Annual, 30 cm. to 1 m. high. Stems tufted, usually ascending from a geniculate or prostrate base, simple or branched from the lower nodes, glabrous, few to many-noded. Leaves 5–15 cm. by 4–8 mm., linear or linear-lanceolate from a slightly contracted and rounded base, acute, flat, flaccid, glabrous or sparingly hairy particularly towards the mouth, margins finely cartilaginous, rough and often crisp, midrib very slender, whitish ; sheaths thin, subherbaceous, loose, glabrous, or more or less beset with spreading tubercle-based hairs often forming a loose beard at the base ; ligules truncate, membranous, up to over 1 mm. long. Spikes mostly 4–9, sessile, subdigitate, solitary or 2–3—nate on a short, scaberulous common axis, erect or spreading, rather slender, strict or slightly flexuous 5–15 cm. long, often finely pubescent at the base ; rhachis almost straight, triquetrous, lateral angles winged, herbaceous, scabrid, internodes up to more than 2 mm. long. Pedicels 2-nate, one very short, the other up to 1·5 mm. long, angular, scabrid. Spikelets appressed, lanceolate, acutely acuminate, 2–4 mm. long, pale greenish, rarely tinged with purple, variously hairy, rarely quite glabrous. Lower involucral glume an ovate, obtuse to subacute membranous scale, usually not over 0·3 mm. long, sometimes obsolete or quite suppressed ; upper ovate-lanceolate, acute, equalling or considerably exceeding half of the upper floral glume, rarely distinctly shorter, 3-nerved, with fine lines of hairs between the nerves and along the margins, rarely quite glabrous. Lower floral glume corresponding in outline and size to the spikelet, firmly membranous, 7-nerved, rarely quite glabrous, usually with fine lines of hairs between the inner side-

nerves (of each half) and along the margins; upper floral glume oblong-lanceolate, acutely acuminate, almost as long as the spikelet, thinly chartaceous, pale or slightly purplish, brownish when ripe. Grain oblong, plano-convex, whitish, scutellum less than half the length of the grain.

This species is not identical with *Paspalum sanguinale*, Lamk. of the F. B. I. or with *Digitaria sanguinalis*, Scop. in Cooke's Flora or in Haines' Bot. of Bihar & Orissa. *D. sanguinalis*, Scop. (*sensu stricio*) is a plant of S. Europe and has not been found either in India or tropical Africa, as was pointed out by Pilger (in Engl. Jahrb. xxx, 118) and Stapf. Most of the numerous synonyms given by Hook. f. in the F. B. I. would have to be mentioned under the different varieties. Here we have to deal only with one variety which was described by Cooke as var. *ciliaris*, Prain and which was called var. *fimbriata* by Stapf.

var. fimbriata, Stapf, l. c. 440.—*Digitaria fimbriata*, Link Hort. Berol. l. c. 226.—*D commutata*, Schult, Mant. ii, 262.—*D. chrysoblephora*, Fig. & De Not. in Mem. Acc. Tor. ser ii, xiv, 364.—*Digitaria ciliaris*, var. *quadristachya*, Wight.—*D. sanguinalis*, var. *ciliaris*, Rendle in Cat. Afr. Pl. Welw. ii, 163, and in Journ. Linn. Soc. Bot. xl, 228.—*Digitoria sanguinalis*, var. *ciliaris*, Prain Beng. Pl. 1181; Cke. ii, 940—*Panicum ciliare*, Retz. Obs. iv, 16; Kunth Enum. i, 82; Roxb. Fl. Ind. i, 290; A. Rich. Tent. Fl. Abyss. ii, 360; Dalz. & Gibs. Fl. Bomb. 290; Duthie Indig. Fodd. Grass. t. 9.—*P. fimbriatum*, Presl Rel. Haenk. i, 298; Kunth Enum. i, 81.—*P. sanguinale* var. *ciliare*, Franch. Contr. Fl. Congo Franc. 46.—*P. sanguinale* var. *blepharanthum*, Hack. in Durand & Schintz Consp. Fl. Afr. v, 762.—*P sanguinale*, var. *macrostachyum*, Hack. l. c. 763.—*Paspalum sanguinale* var, *ciliare*, Hook. f. in F. B. I. vii, 15.

Description: Upper involucral glume usually much exceeding the middle of the fertile floret and frequently equalling ⅘ of its length. Indumentum of spikelets uniform or more often more or less varied in the same inflorescence; hairs of the upper involucral glume and lower floret partly in fine lines, all of one kind, very fine, thin-walled, obtuse-tipped, partly more thick-walled with slightly clavate tips, and up to 1 mm. long, spreading out at maturity and forming a rigid double fringe on each side of the spikelet, the inner fringe often mixed with a varying number of tubercle-based acute yellow bristles which ultimately also spread out at right angles.

It is well to remember what Stapf says in a note, l. c. 441: 'The peculiar indumentum of the spikelets, which in the mature state leads to the formation of spreading fringes, may extend to all spikelets alike or it may be, at least in its perfect development, confined to the long-pedicelled member of each pair of spikelets or only to some of them, in which case the indumentum of the fringeless spikelets approaches more or less that of var. *Linkii*.' Var. *Linkii*, Stapf is Hooker f 's var. *commutatum* of *Paspalum sanguinale* in F. B. I. vii, 15.

Vern. Names: Tara (Surat); Shikaol or Arotaro (Dohad); Chansarieu (Broach); Taro, Modhan (Sind); Fakri, Fakria, Kurad, Suka, Revga, Dinohi, Shikar koli, Kalam hullu (Bijapur); Shimpigyan hullu (Belgaum) (ex Burns).

Locality: *Sind*: Sanghar (Sabnis B903!); Mirpurkhas, in cultivated fields (Sabnis B1209!); Bughar, Indus River (Blatter & McCann D686!); Ghulamalla, garden (Blatter & McCann D687!).—*Gujarat*: Cutch (Blatter 8742!); Ahmedabad (Herb. Econ. Bot. Poona!).—*Khandesh*: N. slope of Chanseli (McCann 9535!); Bor, Tapti Island, on sand and mud (Blatter & Hallberg 5463!); Muravat, Tapti Bank (Blatter & Hallberg 3839!); Umalla (Blatter & Hallberg 5178!); Amalner (Blatter & Hallberg 4443!); Sumit (Blatter & Hallberg 5188!); Bor, Bori River (Blatter & Hallberg 5213!); Dadgaum (McCann 9531!).—*Konkan*: Victoria Gardens, Bombay (McCann 9831!); Versova, Salsette (McCann 4308!); Malabar Hill (McCann 4300!); very common through the Islands of Bombay and Salsette (McCann!); Parsik, railway line (McCann 9530!); Bassein (McCann 4485!); Alibag, sandy shore (Ezekiel!).—*Deccan*: Khandala (McCann 3650!); Igatpuri (McCann 9833!); Purandhar (McCann 5606!); Chattarshinji (Ezekiel!); Pashan (Gammie!); Deolali (Blatter & Hallberg 4556!); Gangapur (Blatter & Hallberg 4581!); Panchgani, Maratha Well (Blatter & Hallberg B1233!).—*S. M. Country*: Haveri, dry ground, compound of P. W. D. (Talbot 2228!); Dharwar (Sedg-

wick !) ; Belgaum (Herb. Bot. Gard. Cal. !).—*Kanara* : Karwar (Talbot 1294 !) ; Haiyal (Talbot 2153 !) ; Kulgi (Talbot 2279 !).

Distribution : Tropics of both hemispheres, rarely found beyond the tropics.

3. **Digitaria pennata**, Chiov. in Result. Scient. Miss. Stefanini—Paoli i, 183 ; Cke. ii, 941, *erronee ascribens nomen Hookero f.* ; Stapf in Prain Fl. Trop. Afr. ix, 472.—*Panicum pennatum*, Hochst. in Flora xxxviii (1855), 197 ; Schweinf. in Bull. Herb. Boiss. ii, App. ii, 18.—*Paspalum pennatum*, Hook. f. in F.B.I. vii, 16.

Description : Cke. l. c.

Locality : *Sind* : Karachi (Stocks *teste* Hook. f.) ; Jemadar ka Landa, near Karachi (Stocks) ; Tatta, Kullan Kote (Blatter & McCann D684 !) ; Tatta (Blatter & McCann D685 !).—*Gujarat* : Porbandar (Bhide !) ; Morvi, Kathiawar (Woodrow).

Distribution : Baluchistan, tropical Arabia and Africa.

4. **Digitaria pedicellaris**, Prain Beng. Pl. (1903), 1181 ; Cke. ii, 941 ; Haines in Bot Bihar & Orissa 1009.—*Paspalam pedicellare*, Trin. ex Steud. Nom. ed. 2 (1841), 272 ; Hook. f. in F.B.I., vii, 19.—*P. pedicellatum*, Nees & Arn. in Wight Cat. 2310 ; Duthie Grass. N. W. Ind. I.—*Milium sanguinale*, Roxb. Fl. Ind. i, 315 (*excl. syn.* Burm.).

Description : Cke. l. c.

Locality : *Konkan* : Thana (McCann 8725 !) ; Sion (Herb. S. X. C. !) ; Mulgaum (McCann 3663 !).—*Deccan* : Chattarshinji Hill, Poona (Ezekiel !).—*S. M. Country* : Hubli, elevation 2,000 ft., rainfall 30 inches (Sedgwick & Bell 4229 !).

Distribution : Throughout India.

5. **Digitaria longiflora**, Pers. Syn. i (1805), 85 (*non* Trin.) ; Cke. ii, 941 ; Stapf in Prain Fl. Trop. Afr. ix, 469 ; Haines in Bot. Bihar & Orissa 1008.—*Digitaria Pseudo-Durva*, Schlechtend. in Linnæa, xxvi, 458.—*D. linearis*, Schult. f. Mant. ii, 264 (*non* Roem. and Schult.).—*D. tenuiflora*, Stapf in Dyer Fl. Cap. vii, 380 (*non* P. Beauv.).—*Paspalum longiflorum*, Retz. Obs. iv, 15 (*non* Trin.) ; Baker Fl. Maurit. 431 ; Hook. f. in F.B.I. vii, 17 (*partim*).—*P. brevifolium*, Fluegge Gram. Monogr. 150.—*P. Pseudo-Durva*, Nees Fl. Afr. Austr. 21.—*P. filiculme*. Nees ex Thw. Enum. Pl. Zeyl. 358.—*Panicum longiflorum*, Gmel. Syst. 158.—*P. parvulum*, Trin. Pan. Gen. 117.—*P. argyrotrichum*, Durand & Schintz Consp. Fl. Afr. v, 741 (*non* Anders.).—*Milium filiforme*, Roxb. Fl. Ind. i, 314.

Digitaria tenuiflora, P. Beauv. given as a synonym by Cke. seems to be a different species. It is apparently a perennial of erect habit and with long narrow leaves.

Description : Cke. l. c.

Locality : *Deccan* : Deolali (Blatter & Hallberg 9835 !).—*S. M. Country* : Dry uplands, Dharwar, elevation 2,400 ft., rainfall 34 inches (Sedgwick 2653 !) ; Belgaum (Herb. Bot. Gard. Cal.).—*Kanara* : Halyal (Talbot 2310 !) ; Londa (Bhide !).

Distribution : Throughout India, Ceylon, tropical and S. Africa, Madagascar, Mascarenes, Malaya.

6. **Digitaria Royleana**, Prain Beng. Pl. (1903), 1181 ; Cke. ii, 942 ; Haines in Bot. Bihar & Orissa 1008.—*Paspalum Royleanum*, Nees ex Thw. Enum. (1864), 358 ; Hook. f. in F.B.I. vii, 18 ; Trin. Fl. Ceyl. v, 125.

Description : Cke. l. c.

Locality : *Konkan* : St. Xavier's College compound (McCann 4533 !) ; Mulgaum, Salsette (McCann 9523 !).—*Deccan* : Khandala (McCann 3651 !) ; Lonavla (Herb. Econ. Bot. Poona !) ; Purandhar Fort (Bhide !) ; Lina Hill, Nasik District (Blatter & Hallberg 4542 !) ; Lohagad, way up (McCann 9512 !) ; Katraj Ghat, 11 miles S.E. of Poona (Bhide !) ; Panchgani, slopes below Third Tableland (Blatter & Hallberg B1229 !) ; Panchgani, Maratha Well (Blatter & Hallberg B1224 !, B1281 !) ; Mahableshwar, in a garden, elevation 4,500 ft., rainfall 270 inches (Sedgwick & Bell 4584 !) ; Suvasni Ghat (Woodrow).—*S. M. Country* : Dharwar, elevation 1,600 ft., rainfall 34 inches (Sedgwick 2843 !) ; Belgaum (Herb. Bot. Gard. Cal. !).—*Kanara* : (Talbot!)

Distribution : Hilly districts throughout India, Ceylon ; apparently not in tropical Africa.

43. ALLOTEROPSIS, Presl, emend. Hitchc. in Contrib. U. S. Nat. Herb. xii, 210; Stapf in Prain Fl. Trop. Afr. ix. 482. (*Axonopus*, Beauv.; Cke. ii, 925).

Stapf (l. c. 483) explains why he adopts *Alloteropsis*, Presl, as emended by Hitchcock. 'As Hitchcock (Contrib. U. S. Nat. Herb. xii, 210) has pointed out, Presl's description and analyses of *Alloteropsis* are based on a composition of a Panicoid and an Andropogonoid grass, whilst the original in Presl's herbarium is undoubtedly the plant described here as *A. semialata*, and so is also the habit figure (1) in Presl's plate. The genus is therefore accepted here with Hitchcock's emendation.'

'Another member of this genus, *A. cimicina*, was included by Palisot de Beauvois (Agrost. 12) in his genus *Axonopus* under its earliest synonym *Milium cimicinum* and as "*A cimicinus*?" on p. 154, and this led J. D. Hooker (Fl. Brit. Ind. vii, 64) to use the name *Axonopus* in preference to *Alloteropsis*, a view which was adopted by myself in Fl. Cap. vii, 418. From P. Beauvois' diagnosis however, and from the fact that he quotes in the first place *Milium compressum* as example for *Axonopus*, there can be no doubt that he had primarily *Milium compressum* in view when establishing his genus *Axonopus*, and it is in that sense that the genus is understood in this work. *A. cimicina* also forms the basis of another genus, *Coridochloa*, Nees in Edinb. New Phil. Journ. xv, 381. A. Chase (in Proc. Biol. Soc. Washington, xxiv, 157) maintains this genus as distinct from *Alloteropsis*, and I followed her when drawing up the key of the genera of Tropical African grasses (p. 13); but I have since come to the conclusion that the species referable to these two groups are so similar in the peculiar structure of their spikelets that they are better merged into one genus for which *Alloteropsis* has priority over *Cordiochloa*.'

We have, therefore, to add the characteristics of the genus as given by Stapf:

Perennial or annual. Leaf-blades flat or more or less convolute; ligules membranous, ciliate or ciliolate, short or reduced to a mere rim. Racemes sessile or peduncled, often more or less compound towards the base, digitate or subdigitate on a more or less elongated common axis. Spikelets ovate or elliptic to lanceolate-oblong; acute or acuminate, mostly awned, slightly or conspicuously compressed from the back, falling entire from the pedicels, 2-nate or fascicled, subsecund and abaxial on the triquetrous rhachis of more or less spiciform racemes. Lower floret usually male, upper hermaphrodite. Involucral glumes unequal, lower smaller, membranous to hyaline, 3-1-nerved, very acute, often mucronulate, upper equal or subequal to the spikelet, membranous to chartaceous, 5-nerved, with the outer nerves submarginal, densely ciliate along them. Lower floral glume resembling the upper involucral glume, but ciliate, pale short, deeply 2-fid with conspicuously auricled flaps, upper floral glume chartaceous, glabrous, delicately ciliolate upwards, 5-nerved, produced into a straight awn or mucronate, pale equal to the glume, 2-keeled, with broadly auricled flaps. Lodicules 2, broadly cuneate. Stamens 3. Styles distinct, stigmas laterally exserted. Grain enclosed by the glume and pale, elliptic-oblong, dorsally much compressed; scutellum about half the length of the grain; hilum basal, punctiform.

Species about 5.—In the tropics and the warm temperate zone of the Old World, 2 in India.

In the Bombay Presidency there is only one species:

1. **Alloteropsis cimicina**, Stapf in Prain Fl. Trop. Afr. ix. 487; Haines in Bot. Bihar & Orissa 1009.—*Milium cimicinum*, Linn. Mant. Alt. 184.—*Panicum cimicinum*, Retz. Obs. iii, 9; Roxb. Fl. Ind. i, 295; Steud. Syn. Pl. Glum. i, 43.—*P conjugatum*, Dalz. & Gibs. Bomb. Fl. 291.—*Axonopus cimicinus* (?), Beauv. Agrost. 154; Hook. f. in F. B. I. vii, 64; Hook. f. in Trim. Fl. Ceyl. v, 166; Cke. ii, 925.—*Urochloa cimicina*, Kunth Rev. Gram. i, 31, t. 103; Dalz. & Gibs. l. c. 289.—*Cordiochloa cimicina*, Nees in Edinb. N. Phil. Journ. xv (1833), 381; A. Chase in Proc. Biol. Soc. Wash. xxiv, 158.—*C. fimbriata*, Nees ex Wight Cat. no. 1656; Aitchis. Cat. Panjab, Pl. 158.

Description: Cke. l. c.

Locality: *Konkan*: Sewri (McCann 3586!); Mulgaum (McCann 3654!).—*Deccan*: Sinhagad forests (Bhide!); Lina Hill, Nasik District (Blatter &

Hallberg 4583 !) ; Panchgani (Hallberg !).—*S. M. Country* : Dharwar (Sedgwick 2032 !, Woodrow) ; Gokak (Shevade !) ; Badami (Woodrow).—*Kanara* : Halyal (Talbot 2294 !) ; Kulgi (Talbot 2434 !).

Distribution : Tropical Africa, Madagascar, throughout India to Java.

44. ERIOCHLOA, H. B. & K. ; Cke. ii, 944.

Species about 25.—In the warm parts of the whole world.

Cooke describes one species : *E. polystachya*, H. B. & K. which name has to cede to *E. ramosa*, O. Kuntze.

1. **Eriochloa ramosa**, O. Kuntze Rev. Gen. Pl. ii, 775 ; Hack. in Bull. Acad. Int. Bot. xvi, 19 ; Merrill in Philipp. Journ. Sc. i, Suppl. 348 ; Stapf in Prain Fl. Trop. Afr. ix, 498 ; Haines in Bot. Bihar & Orissa 1006.—*E. annulata*, Kunth Rev. Gram. i, 30, and Enum. i, 73 ; Duthie List Grass. N. W. Ind. 2 ; Benth Fl. Hongk. 409 ; Hack. in Engl. Jahrb. vi, 233.—*E. polystachya*, Duthie, Ill. Indig. Fodd. Grass. Ind. t. 41 ; Fodd. Grass. N. Ind. 2 ; Hook. f. in F.B.I. vii, 20 ; Cke. ii, 944 ; Rendle in Journ. Linn. Soc. Bot. xxxvi, 320 (*non* H. B. & K. !).—*Milium ramosum*, Retz. Obs. vi (1791), 22 ; Roxb. Fl. Ind. i, 317 ; Griff. Notul. iii, 15 ; Ic. Pl. Asiat. t. 139, f. 60.—*Agrostis ramosa*, Poir. Encycl. Suppl. i, 257.—*Paspalum annulatum*, Fluegge Monogr. Pasp. 133 ; Trin Sp. Gram. Ic. t. 133.—*Helopus lævis*, Trin. ex Spreng. Neue Entdeck. ii, 49, fig. 4.—*H. annulatus*, Steud. Syn. Glum. i, 99 (*non* Nees).—*Pipatherum annulatum*, Presl, Rel. Haenk i, 221 (*non* Raddi).

Note.—Masaja Honda in his Revisio Graminum Japoniæ (Bot. Mag. Tokyo 37 (1923), 113-124) is of opinion that *Eriochloa ramosa*, O. Kuntze, has to be partly emended and changed to the new species *Eriochloa Hackelii*. Details are wanting to form an opinion on this point.

Description : Cke. l. c.

Locality : *Sind* : Umerkot, in a garden (Sabnis B718 !) ; Jamesabad, on banks of a watercourse (Sabnis B967 !) ; Bughar, Indus River (Blatter & McCann D691 !) ; Tatta, Kullan Kote Lake (Blatter & McCann D692 !) ; Tatta (Blatter & McCann D693 !).—*Gujarat* : Ahmedabad (Gammie 16408 !).—*Konkan* : Bassein (Bhide !) ; Antop Hill (McCann 3613 !) ; Alibag, rice field (Ezekiel, !) ; Bandra, on walls and in ditches (McCann !) ; Bombay (Hallberg A141 !) ; Bombay, near Mahim (Woodrow, Lisboa) ; Bhandup, in an old distillery compound, in a ditch (Hallberg A19 !).—*S. M. Country* : Shiggaon, elevation 2,000 ft., rainfall 34 inches (Sedgwick 2356 !) ; Kunnur, elevation 2,000 ft., rainfall 35 inches (Sedgwick & Bell 4937 !) ; Ranibenur (Bhide !) ; Dharwar (Sedgwick !).—*Kanara* : Halyal (Talbot !).

Distribution : Tropics of the Old World, introduced into Ascension Island, St. Helena, Cuba.

45. BRACHIARIA Griseb. in Ledeb. Fl. Ross. iv, 469 ; Stapf in Prain Fl. Trop. Afr. ix, 505.

(Sect. *Brachiaria* and part of sect. *Paspaloideæ* of *Panicum* of the F.B.I.).

Perennial or annual. Leaf-blades linear to lanceolate, usually flat ; ligules reduced to a narrow ciliate or ciliolate rim. Racemes usually subsessile and solitary on a common axis, sometimes bare at the base owing to the arrest of spikelets, rarely truly peduncled and panicled, simple or compound near the base, rarely to or beyoud the middle ; rhachis filiform, triquetrous or more or less flattened and herbaceous with a wavy or zig-zag midrib, which projects as a mostly acute keel on the face ; pedicels solitary or in pairs, alternately to the right and the left of the facial angle or the midrib, if solitary all short or very short, if paired, the primary slightly to very much longer ; spikelets closely appressed, always biseriate in the plane, but frequently becoming 1-seriate by the dovetailing of the alternate spikelets of the closely approximate ranks, more or less contiguous with their sides or imbricate, forming dense, spike-like racemes, or distant by almost their own length or more, glabrous or hairy. Spikelets more or less elliptic or oblong, more or less flattened or slightly depressed, convex on the base, falling entire from the pedicels, 1-2-, rarely more-nate, secund and adaxial (with lower involucral glume towards the axis and the convex side of the upper floral glume away from the axis), closely appressed to and 2-seriate on the triquetrous or flat rhachis of spiciform racemes ; lower floret male or barren with a usually well-developed pale, very

rarely the latter suppressed. Involucral glumes dissimilar and mostly very unequal in length. Lower involucral glume shortest ; upper resembling and more or less equalling the lower floral glume, 5-7- (rarely 9-) nerved. Lower floral glume 5-, rarely 7-nerved, the lateral nerves placed towards the margins and distant from the middle nerve ; pale usually only slightly shorter than the valve with well-developed inflexed flaps, or the latter vanishing above the middle; upper floral glume oblong to elliptic in outline, emucronate, though sometimes contracted into an apiculus, crustaceous or subcoriaceous with firm involute margins, faintly 5-nerved ; pale almost as long as the glume, 2-keeled, its sides tightly embraced by the valve. Lodicules 2, small, broadly cuneate. Stamens 3. Styles distinct ; stigmas plumose, laterally exserted from the upper part of the spikelet. Grain tightly enclosed by the glume and pale, more or less flattened on both faces ; hilum subbasal, punctiform ; embryo half to over $\frac{3}{4}$ the length of the grain.

Species about 80. In the warm parts of the whole world, but chiefly in Africa.

Cooke mentions 3 species which belong to this genus : *Panicum Isachne*, *P. ramosum* and *P. muticum*. To these we add *Brachiaria distachya* (*Panicum distachyum*).

A. Spikelets 0·5 mm. long or slightly more ... 1. *B. Isachne*.
B. Spikelets 2·5-4 mm. long
I. 90 cm. to 1·8 m. high ... ... 2. *B. mutica*.
II. Less than 80 cm. high
1. Spikes 5-many ... ... 3. *B. ramosa*.
2. Spikes 2-4 ... ... 4. *B. distachya*.

1. **Brachiaria Isachne**, Stapf in Prain Fl. Trop. Afr. ix, 552 ; Haines in Bot. Bihar & Orissa 1004 (*habet Roth per errorem*).—*B. cruciformis*, Griseb. in Ledeb. Fl. Ross. iv, 469.—*Panicum Isachne*, Roth ex Roem. & Schult. Syst. ii, 458 ; Roth Nov. Pl. Sp. 54 ; Schult. Mant. ii, 252 ; Steud. Syn. Pl. Gl. i, 57; Hook. f. in F.B.I. vii, 28 ; Stapf in Dyer Fl. Cap. vii, 390 ; Cke. ii, 931.—*P. cruciforme*, Sibth. & Sm. Fl. Græca i, t. 59 ; Baker Fl. Maurit. 434; Schweinf. in Bull. Herb. Boiss. ii, App. ii, 19 ; Duthie Grass. N.W. Ind. 3, Indig. Fodd. Grass. t. 43, Fodd. Grass. N. Ind. 6 ; Boiss. Fl. Or. v, 437.—*P. caucasicum*, Trin. Sp. Gram. Ic. t. 262.—*P. Wightii*, Nees Fl. Afr. Austr. 29.—*P. pubinode*, Hochst. ex. A. Rich. Tent. Fl. Abyss. ii, 363.—*Echinochloa cruciformis*, Koch in Linnæa, xxi, 437 ; Reichb. Ic. Fl. Germ. i, t. 29, fig. 1413.

Description : Cke. ii, 931.

Locality : *Sind* : (Herb. Econ. Bot. Poona !).—*Gujarat* : Surat (Chibber !, Dalzell *teste* Cooke).—*Khandesh* : Sungiri (Gammie 16552 !) ; Dhulia Farm (Chibber !) ; Chanseli (McCann A92 !) ; Nimb, Tapti Bank (Blatter & Hallberg 9571 !) ; Dadgaum (McCann 9562 !) ; Tapti, Bhusawal (Blatter & Hallberg 5156 !) ; Umalla village (Blatter & Hallberg 5159 !) ; Bor, Bori River (Blatter & Hallberg 4424 !).—*Konkan* : Clerk Rd., Bombay, along brackish water (Sabnis 9565 !); very common in Bombay and Salsette Islands (McCann !). —*Deccan* : Yeola (Herb. Econ. Bot. Poona !) ; Mangiri, 8 miles E. of Poona (Gammie !) ; Sholapur (D'Almeida A91 !) ; Deolali (Blatter 9570 !, 9569 !) ; Khandala, common (McCann 9566 !) ; Purandhar, N. foot (McCann 9568 !) ; Panchgani, below Sidney Point (Blatter & Hallberg 1271 !).—*S. M. Country* : Nelogi, elevation 1,800 ft., rainfall 30 inches (Sedgwick 2134 !) ; Haveri (Talbot 2150 !).—*Kanara* : Halyal (Talbot 2150 !).

Distribution : Throughout the plains of India in damp places, Ceylon, westwards to Italy and tropical and S. Africa.

*2. **Brachiaria mutica**, Stapf in Prain Fl. Trop. Afr. ix, 526.—*Panicum muticum*, Forsk. Fl. Aegypt.—Arab. 20 ; Link Hort. Berol. I, 206 ; Hook. f. in F. B. I. vii, 34, and in Trim. Fl. Ceyl. V, 140.— *P. numidianum*, Lam. Ill. I, 172 ; Boiss. Fl. Or. v, 438.— *P. purpurascens*, Raddi ex Opiz in Flora (1822), 266.—*P. barbinode*, Trin. Sp. Gram. Ic. t. 318 ; Duthie List Grass. N. W. Ind. 2.— *P. sarmentosum*, Benth. in Hook. Niger Fl. 561 (*non* Roxb.).— *P. equinum*, Steud. Syn. Pl. Glum. i, 73.— *P. molle*, Griseb. Fl. Brit. West Ind. 547 (excl. syn.); Baker Fl. Maurit. 436.

In adopting Forskal's name '*muticum*' for this species Stapf, according to his own words, has relied on Ascherson's indentification (Asch. & Schweinf. Ill. Fl. Egypt 160) of the type with the Algerian *P. numidianum*.

Popular Names : Water Grass, Mauritius Grass, Para Grass, Scotch Grass, Buffalo Grass.

Description : Perennial 1–2·5 m. high. Stems ascending from a sometimes prostrate and copiously rooting base, stout, terete, usually many-noded and sheathed high up, simple or sparingly branched, glabrous, often waxy, pruinose below the nodes. Leaf-blades linear, up to 30 cm. long, 6–10 mm. broad glabrous or rarely more or less hirsute, margins scabrid. Panicle oblong to ovate-oblong in outline subsecund or almost quaquaversal, 6-20 cm. long ; common rhachis terete to semiterete, more or less deeply channelled or triquetrous upwards, scabrid along the angles, glabrous. Racemes numerous, solitary or irregularly approximate, sometimes paired or in false whorls, shortly peduncled or subsessile, obliquely spreading, 7 (rarely 12) to 2·5 cm. long, mostly compound, glabrous, greenish or tinged with purple ; rhachis flat, with a slender, raised midrib up to 1 mm. wide, villosulous at the base, otherwise glabrous ; secondary racemes usually very short, and 6–3-spiculate ; pedicels solitary or paired, very short, or if paired then the longer up to 1 mm. long, frequently with a few setules. Spikelets laterally contiguous or discontiguous, those of the secondary racemes often imbricate, oblong or lanceolate-oblong, acute, 3–3·5 mm. long, glabrous. Involucral glumes dissimilar, lower broad-ovate, acute to subacute, from less than $\frac{1}{3}$ to not quite $\frac{1}{2}$ the length of the spikelet, faintly 3–5-nerved, often tinged with purple ; upper corresponding in outline and size to the spikelet, 5–7-nerved. Lower floral glume as long as the upper involucral glume and similar to it ; pale narrowly oblong, subacute, almost as long as the glume, with narrow flaps ; anthers 2 mm. long ; upper floral glume slightly shorter than the spikelet, mostly 3 mm. long, oblong, subacute or minutely apiculate, pale yellowish, glume and pale crustaceous, very finely transversely wrinkled or almost smooth. Stigmas blackish-purple, very conspicuous.

Locality : Cultivated at Kirkee and Surat (Woodrow) and very likely in other places.

Distribution : A native of S. America and W. Africa, but introduced elsewhere (Stapf).

Uses : A fodder grass. See Kew Bull. (1894), 384.

3. **Brachiaria ramosa**, Stapf in Prain Fl. Trop. Afr. ix, 542 ; Haines Bot. Bihar & Orissa 1005.—*Panicum ramosum*, Linn. Mant. (1767), 29 ; Steud. Syn. Pl. Glum. i, 97 ; Hook. f. in F.B.I. vii, 36 (*partim*) ; Trim. Fl. Ceyl., v, 140 ; Prain Beng. Pl. 1175 ; Cke. ii, 932.—*P. arvense*, Kunth Rev. Gram. i, 391, t. 109.—*P. Petiveri*, Dis. ii, 144. (*partim*) ; Baker Fl. Maurit. 434 ; Aitchis. Cat. Panjab Pl. 160 ; Duthie Grass. N. W. Ind. 6, Fodd. Grass. N. Ind. 11 ; Boiss. Fl. Or. v, 439.—*P. brachylachnum*, Steud. l c. 62.—*P. cognatissimum*, Steud. l.c. 69.—*P. patens*, Boj. Hort. Maurit. 365 (*non* Linn.).—*P. pygmaeum*, Boj. l.c.—*P. Helopus*, Watt. Dict. Econ. Prod. vi, part 1, 10 (*partim*).—*P. umbrosum*, Retz. Obs. 4 (1786), 16 ; Roxb. Fl. Ind. i, 297.

Description : Cke. ii, 932.—Stapf points out that this species occurs in a glabrous and a pubescent state, and that the original specimen in Linnæus' herbarium represents the former. 'The pubescence,' he says, 'if present, extends generally to the culms, the leaves, the axes of the inflorescence and the spikelets, the upper glume [upper involucral glume] and lower valve [lower floral glume]. On the blades it may be scanty and disappear with age. It does not seem to be correlated with any other character, and the area of the glabrous and pubescent states overlap completely, in fact both have been taken in the same collecting.'

He mentions another curious modification in which the lower floral glume is more firmly membranous to crustaceous and faintly transversely rugose and thus more or less resembles the upper floral glume (not the upper involucral glume as is normally the case). It has been collected in India and W. Africa.

Locality : *Sind* : Chachra (Mamlatdar of Chachra !) ; Shahabander (Karachi P.O.C. of Shahabander !) ; Sangarh (Sabnis B901 !, B887 !) ; Nasarpur, clayey soil (Sabnis B1057 !).—*Gujarat* : Ahmedabad (Herb. S.X.C. 2165 !); Mausari (Mamlatdar of Mausari !) ; Sumrasar, Cutch (Blatter 3756 !).—*Khandesh* : Tamer, Tapti bank (Blatter & Hallberg 5172 !) ; Antroli, Bori River (Blatter & Hallberg 5149 !) ; Toranmal (McCann A142 !).—*Konkan* : Malabar Hill (McCann !) ; Versova (McCann 9588 !) ; Byculla (McCann 9586 !) ; Sion (McCann 8689 !) ; Bandra Hill, in fallow fields (Vakil A115 !).—*Deccan* : Khandala (Sedgwick 2631 !) ; Poona (Woodrow !) ; Lina Hill, Nasik District

(Blatter & Hallberg A145!).—*S. M. Country*: Dharwar, garden weed (Sedgwick 2651!); Haveri (Talbot 2231!); Badami (Woodrow *teste* Cooke).
Distribution: Throughout India, Ceylon, Afghanistan, tropical Africa (Upper Guinea, Cape Verd Islands).

4. **Brachiaria distachya**, Haines in Bot. Bihar & Orissa 1004 (*per errorem distachyum*).—*Panicum distachyum*, Linn. Mant. i, 138; Retz. Obs. iii, 17; Lamk. Ill. t. 43, f. 2; Steud. Syn. Gram. 41; Aitchis. Cat. Panjab, Pl. 159; Duthie Grass N. W. Ind. 3; Indig. Fodd. Grass. t. 42, Fodd. Grass. N. Ind. 6; Benth. Fl. Austral. vii, 478; Hook. f. in F.B.I. vii, 37.— *P. subquadriparum*, Trin. Gram. Panic. 145, Sp. Gram. Ic. t. 186.—*Digitaria distachya*, Pers. Syn. i, 85.

Description: A slender, creeping grass, glabrous or panicle sparsely hairy. Stems 30-60 cm. high. Leaves linear or lanceolate or linear-lanceolate, acuminate, 5–15 cm. by 3–6 mm., widest at the rounded or amplexicaul base, flat; sheaths ciliate or not on the margins, mouth hairy. Spikes 2-4, distant, 2 5-6·5 cm. long, rarely more than 10 cm., erect, at last spreading; rhachis slender, glabrous. Spikelets variable in size, pale green, 3–4 mm. long, solitary, subsessile, spikately arranged in 2 (-1) series, ellipsoid, glabrous. Lower involucral glume embracing the spikelet and margins overlapping below, ⅓ to nearly ½ the spikelet, 5–7-nerved, obtuse or subacute; upper involucral glume ovate, acute, 7-nerved, paleate or not, pale if present narrow, neuter. Lower floral glume 5-nerved, upper ellipsoid, obtuse or rounded, 2 mm. long, brown and minutely transversely lineolate or obscurely rugulose when ripe.
Locality: *Gujarat*: Ahmedabad, banks and margins of fields around Ahmedabad (Sedgwick 239!).—*S.M. Country*: Dharwar (Sedgwick 2840!).
Distribution: India, Ceylon, China, Malaya, Australia.

46. PASPALUM, Linn. Syst. Nat. ed. x, 855; Cke. ii, 943.

Species over 200, chiefly in tropical America, only a few in the Old World.
Cooke describes 3 species: *P. scrobiculatum*, Linn., *P. compactum*, Roth. and *P. distichum*, Linn., to which we add *Paspalum dilatatum*, Poir. *P. distichum* has to be replaced by *P. vaginatum*, Sw., for reasons detailed below.

I. Leaves over 14 cm. long
  1. Plant 60–90 cm. high ... ... 1. *P. scrobiculatum.*
  2. Plant 1-1·5 m. high ... ... 2. *P. dilatatum.*
II. Leaves less than 11 cm. long
  1. Leaves 2·5–7·5 cm long, 8–12 mm. broad ... ... 3. *P. compactum.*
  2. Leaves 5–10 cm. long, 1·2–4 mm. broad ... ... 4. *P. vaginatum.*

1. **Paspalum scrobiculatum**, Linn. Mantiss. (1767), 29; Hook. f. in F. B. I. vii 10; Cke. ii, 943; Haines in Bot. Bihar & Orissa 1000.—*P. scrobiculatum*, Linn. var. *Commersonii*, Stapf in Prain Fl. Trop. Afr. ix, 573.—*P. scrobiculatum*, Linn. var. *frumentaceum*, Stapf l. c. 575.—*P. scrobiculatum*, Linn. var. *polystachyum*, Stapf l. c. 576.—For further synonyms see Hook. f. and Stapf ll. cc. Hook f. gives *P. orbiculare*, Forst. Prodr. 7 as a synonym, but Stapf considers it as a distinct species of the Polynesian and Indo-Malayan regions with an extension into New Zealand and Australia. Of Hook. f. syn. in the F. B. I. we wish to enclose only those which apply to spontaneous forms of the Old World.
As can be seen from the above synonymy we are not following Stapf in distinguishing several varieties or rather forms. He takes the cultivated forms of India to be the original *P. scrobiculatum* of Linnæus and calls it *P. scrobiculatum* var. *frumentaceum*. All the spontaneous forms of *P. scrobiculatum* as understood by most post-Linnæan authors are put by Stapf under *P. scrobiculatum*, Linn. var. *Commersonii*, the type for this combination being *P. Commersonii*, Lam. Ill. i, 175, t. 43, fig. 1. The third form var. *polystachyum* does not seem to occur in India.
Description: Cke. l. c.
Locality: *Sind*: Jamesabad, in bed of watercourse (Sabnis B979!); Bohara (Blatter & McCann D689!).—*Konkan*: Victoria Gardens, Bombay (McCann 4297!); Mulgaum, Salsette (McCann 3607!); Parsik, between stones of railway tract (McCann 9516!); Vihar Lake, Salsette (McCann 9517!).—*Deccan*;

Khandala, in watercourse, on sandy soil (McCann 9824 !).—*S. M. Country*: Konankeri, Dharwar District, elevation 1,800 ft., rainfall 40 inches (Sedgwick & Bell 4966 !) ; W. of Dharwar, elevation 2,000 ft. rainfall 40 inches (Sedgwick & Bell 4452 !) ; Dastikop, elevation 2,500 ft., rainfall 35 inches (Sedgwick 2109 !) ; Dharwar (Garade !) ; Belgaum (Herb. Bot. Gard. Cal. !).— *Kanara* : Halyal (Talbot 2297 !) ; Karwar (Herb. Econ. Bot. Poona 2297 !, 618 !) ; Castle Rock (Gammie !).

Distribution : Tropics of the Old World.

*2. **Paspalum dilatatum,**[1] Poir. Encycl. v, 35 ; New South Wales Agric. Gaz. x (1899), 32, with plate ; Trin. Diss. 11, 113, with plates ; Agric. Grass. U. S. 31-32 ; H. H. Mann in Dept. Agric. Bomb. Bull. 77, 68.—*P. ovatum*, Nees ex Trin. Gram. Panic. 113.— *P. pratense*, Spreng Syst. i, 247.—*P. Selloi*, Spreng. ex Nees Agrost. Bras. 43.

Popular Names : Golden Crown Grass, Hairy-flowered Paspalum.

Description : A tall, erect grass, about 1–1·5 m. high. Culm developing from a thick rootstock with 3–5 leaves ; leaf at base of culm often about 30 cm. long, 8–12 mm. broad, smooth on both sides, rugose along the margins. Raceme 12–30 cm. long, having 5–10 somewhat spreading spikes, which are 7 cm. or more in length, 2·5–5 cm. apart, upper ones gradually shorter. Spikelets closely arranged in 4 rows, two on each side of the narrow and nearly straight axis in alternate pairs, 1·5–2 mm. wide, and 3–4 mm. long, ovate, acutely pointed, crowded and overlapping each other, compressed, margins clothed in silky hairs. Involucral glumes ovate, acute, 5-nerved, nearly smooth except the fringe of white hairs on the margin. Floral glumes thick, hard, and firm, very minutely punctate. Pale fitting inside the flowering glume and enclosing the stigmas and styles. Anthers linear. Styles 2 ; stigmas blackish-purple, plumose.

Locality : Cultivated. See Mann, l. c.

Distribution : Virginia, Mississippi, Louisiana, Texas, S. America, especially Brazil.

Uses : One of the best fodder grasses in N. America and is extensively cultivated there. For a full account see Kew Bull. (1902), 1-4.

3. **Paspalum compactum,** Roth Nov. Pl. Sp. (1821), 36 ; Kunth Enum. Pl. i, 61 ; Steud. Syn. Gram. 31 ; Hook. f. in F. B. I. vii, 12 ; Cke. ii, 943.—*P. miliaria*, C. Muell. in Bot. Zeit. xix (1861), 325.—*P. Canaræ*, Steud. l. c. 58.—*P. imperfectum*, Roxb. ex Kunth l.c.

Description : Cke. l.c.

Locality : *Konkan* : Tiwari-Pada, Bassein (Herb. Econ. Bot. Poona 1690 !) ; Matheran, to Louisa Point (D'Almeida A243 !).—*Deccan* : Khandala, growing in gravelly soil, very common (McCann 9823 !) ; Igatpuri, very common (McCann 4587 !) ; Panchgani, First Tableland (McCann B1300! B1265 !), Second Tableland (McCann B1242 !, B1292 !) ; Mahableshwar (Cooke, Woodrow).— *S. M. Country* : Londa (Bhide !) ; Belgaum (Hole 15 !).—*Kanara* : Yellapore (Talbot 657 !) ; Tinai (Talbot 2566 !) ; Castle Rock, elevation 1,900 ft., rainfall 250 inches (Sedgwick 2752 !) ; Karwar, Bingy Ghat (a very villious form, McCann) (Talbot 1529 !) ; Devimani, elevation 1,300 ft. (McCann A17 !).

Distribution : W. Peninsula of India.

4. **Paspalum vaginatum,** Sw. Prodr. Veg. Ind. Occ. 21, Fl. Ind. Occ. i, 135 ; Trin. Gram. Pan. 94, Panic. Gen. 53, Sp. Gram. Ic. t. 120 ; Kunth Enum. i, 52 ; Steud. Syn. Pl. Glum. i, 20 ; Hitchcock & Chase in Contrib. U. S. Nat. Herb. xviii, 307 (*non* P. Beauv. Fl. Owar.) ; Stapf in Prain Fl. Trop. Afr. ix, 570.—*P. vaginatum, forma longipes*, Lange in Vidensk. Medd. Naturh. Foren. Kjöbenh. (1854), 42, Pug. Pl. Hisp. i, 28.—*P. distichum*, N. L. Burm. Fl. Ind. 23 ; Gaertn. Fruct. ii, 2, t. 80 ; Kunth l. c. ; Steud. l. c. 29 ; Baker Fl. Maurit. 431 ; Benth. Fl. Austr. vii, 460 ; Hack. in Forschungsr. S. M. S. 'Gazelle' iv. 6 ; Hook. f. in F. B. I. vii, 12 ; Rendle in Journ. Linn. Soc. Bot. xxxvi. 319 ; Cke. ii, 943 ; Ridley Mat. Fl. Mal. Pen. iii, 124 ; Stapf in Dyer Fl. Cap. vii, 371 ; Merrill in Philipp. Journ. Sc. i, Suppl. i, 346 (*non* Linn.).—*P. distichum*, var. *vaginatum*, Griseb. Fl. Brit. W. Ind. 541.—*P. littorale*, R. Br. Prodr. 188 ; Trin.

[1] We have to thank Mr. K. Biswas, the Curator of the Herbarium of the Sibpur Botanic Garden, for most of the information contained under this species.

Gram. Pan. 95, Sp. Gram. Ic. t. 112.—*P. longiflorum*, P. Beauv. Fl. Owar. ii, 46, t. 85, fig. 2; Grah. Cat. Bomb. 234 (*non* Retz.).—*P. brachiatum*, Trin. ex Nees Agrost. Bras. 62.—*P foliosum*, Kunth Rev. Gram. i, 25.—*P. squamatum*, Steud. l. c. 21.—*P. inflatum*. A. Rich. in Ram. de Sagra Fl. Cub. iii. 298.—*P. kleinianum*, Presl Rel. Haenk. i, 209.—*P. Boryanum*, Presl l. c.—*Ligitaria foliosa*, Lag. Gen. *et* Sp. Nov. 4.—*D. vaginata*, Philippe Fl. d. Pyren. ii, 415.—*D. paspaloides* var. *longipes*, Lange ex Willk & Lange Prodr. Fl. Hisp. i, 45.—*Sanguinaria vaginata*, Bub. Fl. Pyren. iv, 258.

To explain the change of name from *P. distichum*, Linn. to *P. vaginatum*, Sw. and to elucidate certain points of the above synonymy taken from Stapf, it will suffice to quote the short explanation given in the Fl. Trop. Afr. p. 572: 'Frequently confused with *Paspalum distichum*, Linn. (Herb. Linn.!) which has broader and flatter leaves, mostly sessile or subsessile lateral spikes and spikelets with firmer sides and a more convex upper glume which is appressedly and silky pubescent.'

Description: Cke. ii, 943.

Locality: *Gujarat*: Marshy edge of the Bokh, Prantij (Herb. Econ. Bot. Poona!).—*Konkan*: Marine Lines, Bombay (Hallberg 9514!); sea-shore, Bombay (Woodrow); Malabar Hill, Bombay (McCann 3609!); St. Xavier's College compound (McCann 9830!); Alibag, sandy shore (Ezekiel!); Malwan (Woodrow).

Distribution: Tropics of the whole world, mostly on the sea-shore; introduced into Galicia (Spain) and the Western and Central Pyrenees.

47. PASPALIDIUM, Stapf in Prain Fl. Trop. Afr. ix (1917), 15 *clavi et l. c.* (1920), 582.

(Sect. *Paspaloideæ* in F. B. I. *partim*).

Perennial, semiaquatic or terrestrial. Leaves linear, flat or involute. Ligule a ciliolate rim. Racemes sessile or sub-sessile and secund on the alternate notches of a triquetrous common axis of a false compound spike, more or less appressed to the more or less hollowed-out flanges of the latter. Rhachis ending in a subulate point. Spikelets mostly conspicuously 2-seriate, nearly always quite glabrous, ovate to ovate-oblong or ovate-lanceolate (when seen in front view), awnless, falling entire from the pedicels, solitary, secund and abaxial on the rhachis. Involucral glumes mostly dissimilar and very unequal in length; lower reduced to a small scale or up to, rarely over, half the length of the spikelet, upper mostly almost equalling the spikelet, 5-7-nerved with the nerves evenly distributed, rarely both glumes much reduced. Lower floral glume similar to the upper involucral glume with the inner side-nerves more distant, pale if present only slightly shorter than its glume with well developed inflexed flaps; upper floral glume oblong to elliptic in outline, acute to apiculate; emucronate, crustaceous with firm involute margins, faintly 5-nerved, pale almost as long as its glume, 2-keeled, its sides tightly embraced by the glume all along. Lodicules 2, small, broadly cuneate. Stamens 3. Styles distinct; stigmas plumose, laterally exserted from the upper part of the spikelet. Grain tightly enclosed by the more or less hardened glume and pale.

Species about 12.—In the warm countries of the whole world. Six are confined to Australia and New Caledonia.

Cooke (ii, 929) describes 3 species belonging to this genus: *Panicum flavidum*, Retz., *P. punctatum*, Burm., and *P. fluitans*, Retz. We retain all, but substitute the older name *geminatum* for *fluitans*.

I. Lower spikes shorter than the internodes. Upper involucral glume shorter than the upper floral glume ... ... 1. *P. flavidum*.

II. Lower spikes as long as or longer than the internodes. Upper involucral glume about ½ the upper floral glume ... ... 2. *P. punctatum*.

III. Lower spikes as long as or shorter than the internodes. Upper involucral glume mostly as long as the upper floral glume ... ... 3. *P. geminatum*.

1. **Paspalidium flavidum**—A. Camus in Lecomte Fl. l'Indo-Chine, vii 1, 419; Haines in Bot. Bihar & Orissa 1001 (*erronee attribuens combinationem Stapfio*) —*Panicum flavidum*, Retz. Obs. iv (1786), 15; Griff. Notul. iii, 33; Ic. Pl. As. t. 139, fig. 67; Duthie Grass. N. W. Ind. 3, Indig. Fodd. Grass. t. vi,

Fodd. Grass. N. Ind. 7; Benth. Fl. Austr. vii, 474; Hook. f. in F.B.I. vii, 28; Cke. ii, 929.—*P. brizoides*, Jacq. Eclog. Gram. (1813), 2, t. 2; Roxb. Fl. Ind. i, 293; Dalz. & Gibs. Bomb. Fl. 290; Duthie Grass. N. W. Ind. 2; Aitchis. Cat. Panjab Pl. 159; Baker Fl. Maurit 433.—*P. floridum* Royle Ill. Bot. Himal. 420.

Description : Cke. ii, 929.

Locality : *Sind :* Sanghar (Sabnis B762!).—*Gujarat:* Near Surat (Dalzell & Gibson *teste* Cooke); Morvi, Kathiawar (Woodrow *teste* Cooke); Porbandar, Kathiawar (Woodrow *teste* Cooke).— *Konkan* : Mulgaum (McCann 9579!); Thana (McCann 8726!); N. & S. Konkan (Laws *teste* Cooke).— *Deccan* : Poona (Bhide!); Mr. Gammie's compound, Kirkee (Bhide 894!); Khandala (Woodrow *teste* Cooke!).— *S. M. Country* : Konankeri, in a small tank, elevation 1,800 ft., rainfall 40 inches (Sedgwick & Bell 4964!); Belgaum (Herb. Econ. Bot. Poona!).—*Kanara* : Yellapore (Talbot!); Halyal (Talbot 2095!).

Distribution : Plains of India, Ceylon, tropical Asia (not in tropical Africa as reported by Hook. f. and Cooke).

2. **Paspalidium punctatum,** A. Camus in Lecomte Fl. l'Indo-Chine, vii, 419; Haines in Bot. Bihar & Orissa 1001 (*erronee attribuens combinationem Stapfio*).—*Panicum punctatum*, Burm. Fl. Ind. (1768), 26; Hook. f. in F.B.I. vii, 29; Cke. ii, 929.

Description : Cke. l.c.

Locality : *Deccan* : Poona (Woodrow, Lisboa); Ahmednagar (Woodrow).

Distribution : Throughout India in marshes, Ceylon, Malaya (not in tropical Africa).

3. **Paspalidium geminatum**, Stapf in Prain Fl. Trop. Afr. ix (1920), 583; Haines in Bot. Bihar & Orissa 1002.—*Panicum geminatum*, Forsk. Fl. Aegypt.—Arab. 18; Schweinf. in Bull Herb. Boiss. ii, App. ii, 19; Hack. in Bull Herb. Boiss. iv, App. iii, 14; Hitchcock & Chase in Contrib. U.S. Herb. xv, 30.—*P. fluitans*, Retz. Obs. iii, 8 *et* v, 18; Willd. Sp. Pl. i, 338; Kunth Enum. i, 78; Steud. Syn. Pl. Glum. i, 59; Miq. Fl. Ind. Bat. iii, 455; Baker Fl. Maurit. 433; Cke. ii, 929.—*P. brizoides*, Lam. Ill., 1, 170 (*non* Retz.).—*P. paspaloides*, Pers. Syn. i, 81; Kunth Enum. i, 77; Steud. l.c. 60; Boiss. Fl. Or. v, 436; Balfour f. Fl. Socotra 310; Hook. f. in F.B.I. vii, 30, in Trim. Fl. Ceyl. v, 135.—*P. beckmanniæforme*, Mikan ex Trin. in Spreng. Neue Entdeck. ii, 83; Spreng. Syst. i, 309.—*P. truncatum*, Trin. Diss. ii. 130, *et* Sp. Gram. Ic. t. 168.—*P. affine*, Nees Agrost. Bras. 113.—*P. brizaeforme*, Presl Rel. Haenk. 302; Steud. l.c. 60.—*P. numidianum*, Sieb. ex Schult. Mant. ii, 267 (*non* Lam.). *P. carnosum*, Salzm. ex Steud. l.c.—*P. appressum*, Doell. in Mart. Fl. Bras. ii, ii, 184.—*P. glomeratum*, Buckl. Prel. Rep. Geol. Agr. Surv. Tex. app. 3 (*non* Moench.).—*P. turgidum*, Cheval Sudania 25.—*Paspalum appressum*, Lam. Ill. i, 176.—*Digitaria appressa*, Pers. l.c. 85.—*D. affinis*, Roem. & Schult. Syst. ii, 470.

Description : Cke. ii, 929.

Locality : *Sind* : Munchar Lake (Stocks *teste* Cooke); Tatta (Blatter & McCann D611!, D612!).—*Gujarat* : Porbandar (Bhide!); Lasundra (Chibber!); Ahmedabad, canal banks (Sedgwick!); Cutch, Anjar, tank (Blatter 3745!).—*Khandesh* : Dhulia (Chibber!); Borod, growing in water, partly submerged (McCann A97!).—*Konkan* : Mahaluxmi (Sabnis 5449!); opposite Kantwadi, sandy shore, Bandra (Vakil A99!); Victoria Gardens (McCann A100!); common in Bombay Isl. (McCann!).—*Deccan* : Bund Gardens, Poona (Garade 343!); sides of stream Dangar Guy, Ahmednagar (T. Cooke 6!); Manmad, river bed (Blatter A94!); Sholapur Tank, in water (D'Almeida A95!); Pashan (Gammie!); Igatpuri (Blatter & Hallberg 5492!).—*S. M. Country* : Dharwar (Sedgwick 3692!); Shiggaon (Sedgwick 2081!).—*Kanara* : Halyal (Talbot 2149!).

Distribution : More or less throughout India, Ceylon, Afghanistan, Arabia, tropical Africa and America.

48. UROCHLOA, Beauv. Agrost. 52, t. xi, fig. 1; Stapf in Prain Fl. Trop. Afr. ix, 586.

Perennial or annual. Leaves linear to lanceolate, flat; ligules a ciliate rim. Racemes sessile or subsessile on a common axis, simple or nearly so; rhachis more or less triquetrous with a low almost straight or zigzag facial angle or keel,

rarely strap-shaped ; pedicels solitary or in pairs, alternately to the right and the left of the facial angle, usually reduced to short disc-tipped stumps, or if binate the primary slightly longer. Spikelets close, contiguous or slightly discontiguous, 2 or irregularly pluri-seriate, glabrous or hairy, broad-ovate to elliptic or lanceolate-oblong, awnless, usually more or less flattened or slightly depressed abaxially, convex on the back, falling entire from the pedicels, solitary or binate or in fascicles of 3-4, secund and abaxial on the rhachis, involucral glumes similar and subequal or more often dissimilar and very unequal in length, the ower being the shorter, upper resembling and more or less equalling the lower floral glume, 5–11 (mostly 7-) nerved. Lower floral glume 5–7-, rarely more-nerved the inner lateral nerves somewhat distant from the midnerve, pale subequal to the glume, with well-developed inflexed flaps and sharp sometimes marginate keels ; upper floral glume elliptic to rotundate-elliptic in outline, very obtuse, with usually scabrid or barbellate mucro, narrowly involute, 5-7-nerved, pale almost as long as the glume, 2-keeled, the sides tightly embraced by the valve all along. Lodicules 2, small, broadly cuneate. Stamens 3 ; styles distinct ; stigma plumose, laterally exserted upwards. Grain tightly enclosed by the glume and pale, broadly to rotundate-elliptic, dorsally compressed.

" Very similar to *Brachiaria*, but with the orientation of the spikelets inverted and a short fine mucro from the very obtuse apex of the fertile valve. Although very similar in general appearance, none of the species of *Urochloa* can be said to approach closely members of the genus *Brachiaria*. Their affinities are clearly *inter se*, suggesting a distinct line of evolution. The occurrence of parallel states, one with glabrous, the other with pubescent spikelets, but otherwise indistinguishable, runs almost through the whole genus. To this may be added the presence of a submarginal fringe in the lower floret, almost normal in some and very rare in other species, and apparently in no case correlated with other characters." (Stapf l.c.).

Species about 18.—Hot parts of the Old World, one in America, but perhaps introduced.

Cooke describes 3 species of *Panicum* which belong here : *Panicum prostratum*, Lamk., *P. setigerum*, Retz., and *P. Javanicum*, Poir., to which we add *Urochloa marathensis*, Henrard.

A. Spikelets up to 2 mm. long ... ... 1. *U. reptans.*
B. Spikelets 2·5–5 mm. long
I. Spikelets lanceolate, acuminate ... 2. *U. setigera.*
II. Spikelets ovate to elliptic-oblong
1. Leaves about 3 cm. long Racemes 2 cm. long ... ... 3. *U. marathensis.*
2. Leaves 3·5–15 cm. long. Racemes 2·5–5 cm. long ... ... 4. *U. Helopus.*

1. **Urochloa reptans**, Stapf in Prain Fl. Trop. Afr. ix, 601 ; Haines in Bot. Bihar & Orissa 1003.—*Panicum reptans*, Linn. Syst. Nat. ed. x, 870 ; Hitchc. & Chase in Contrib. U. S. Nat. Herb. xv, 36, fig. 17, excl. *P. grossarium*. —*P. repens*, N. L Burm. Fl. Ind. 26, t 11, f. 1 ; Rottl. in Neue Schrift. iv, 182 ; Roxb. Fl. Ind. i. 302 ; Boi. Hort. Maur. 364 (*non* Linn).—*P. prostratum*, Lam. Ill. i, 171 ; Miq. Fl. Ind. Bat. iii, 446 ; Griseb. Fl. Brit. W. Ind. 546 ; Schweinf. in Bull. Herb. Boiss. ii, App. ii, 20 ; Baker Fl. Maur. 435 ; Duthie List. Grass. N. W. Ind. 6 ; Ill. Indig. Fodd. Grass. t. 45 ; Fodd. Grass. N. Ind. 11 ; Boiss. Fl. Or. v, 438 ; Dalz. & Gibs. 290 ; Hook. f. in F.B.I. vii, 33 ; Cke. ii, 932 ; Merrill in Philipp. Journ. Sc. i, 355.—*P. barbatum*, Lam. l. c. —*P. cæspitosum*, Sw. Fl. Ind. Occ. i, 146. —*P. Sieberi*, Link Hort. Berol. i, 207. —*P. procumbens*, var. Nees Agrost. Bras.109.—*P. crispum*, Llanos, Fragm. 42. —*P. insularum*, Steud. Syn. Pl. Glum. i, 61.—*P. calacczense*, Steud. l.c. 65. —*P. aurelianum*, Hale in Wood Classb. ed. iii, 787.—*P. viaticum*, Salzm. ex Doell in Mart. Fl. Bras. ii, ii, 155.—*P. marginatum*, Vahl ex. Hook. f. l. c.—*Brachiaria prostrata*, Griseb. in Abh. Ges. Wiss. Goett. vii, 263.

Description : Cke. ii, 932, under *Panicum prostratum*.

Locality : *Gujarat* : Ahmedabad, famine grass plot, Bedar (Herb. Gujarat College !) ; Ghad, on black soil (Sedgwick 1124 !).—*Khandesh* : Nandurbar, (Mamlatdar of Nandurbar !) ; Umalla, Tapti bank (Blatter & Hallberg 5229 !); Bor, Tapti (Blatter & Hallberg 4417 !).—*Konkan* : Vasco da Gama (Bhide !); Matunga, salt pans (Sabnis 9572 !) ; Byculla (McCann 9577 !).—*Deccan* : Kirkee

(Bhide !) ; Poona (Herb. Econ. Bot. Poona !) ; Deolali (Blatter A107 !) ; Sholapur (D'Almeida A108 !, A109 !).—*S. M. Country* : S. W. of Dharwar, elevation 1,800 ft., rainfall 90 inches (Sedgwick & Bell 4437 !) ; Dharwar, under trees on black soil, elevation 2,400 ft., rainfall 34 inches (Sedgwick 2882 !).

Distribution : Plains of India, Ceylon, Tropics generally, subtropical America, also tropical Arabia and the Mascarenes.

2. **Urochloa setigera**, Stapf in Prain Fl. Trop. Afr. ix, 598 ; Haines in Bot. Bihar & Orissa 1003.—*Panicum setigerum*, Retz. Obs. iv, 15 ; Roxb. Fl. Ind. i, 299 ; Kunth Enum. i, 90 (*excl. syn. nonnullis*) ; Hook. f. in F. B. I. vii, 37 ; Trim. Fl. Ceyl. v, 141 ; Cke. ii, 933.—*P. affine*, Poir. Encycl. Suppl. iv, 273 (ex Kunth).

Description : Cke. ii, 933, under *Panicum setigerum*.

Locality : *Sind* : Mirpur Sakro (Blatter & McCann D609 !); Gharo (Blatter & McCann D610 !).—*Gujarat* : Rajkot, Kathiawar (Woodrow 45 *teste* Cooke !).—*Khandesh* : Dhulia (Herb. Econ. Bot. Poona !).—*Konkan* : Bassein (Paranjpe !).—*Deccan* : Ganeshkhind Bot. Gardens (Herb. Econ. Bot. Poona !) ; Mangiri Farm, 11 miles S. E. of Poona (Herb. Econ. Bot. Poona !).

Distribution : India, Ceylon, Mauritius, tropical and S. Africa.

Note : We do not think there is any good reason for retaining Hook. f.'s var. *tomentosa* which was also mentioned by Cke. l. c. We refer to the note given above after the general characteristics of the genus and add what Stapf says with regard to this species in particular : 'The African specimens have glabrous spikelets. In India, however, the pubescent form appears to be prevalent.'

3. **Urochloa marathensis**, Henr. in Mededeel. Rijks Herb. 43 (1922), 1-3, pl. 1. —*Panicum marathense*, Henr. in Herb. Lugd. Bat.

Distribution : Annual, dwarf and robust, glaucous, branching from the lower geniculations. Stems low, striate, quite glabrous, few-noded, nodes pubescent. Leaf-sheaths terete or slightly compressed, striate, lower ones gaping, upper ones tight, shorter than the internodes, hirsute with bulbous-based hairs. Ligule very short, covered with long hairs. Blade cordate at the base, linear-lanceolate, gradually acutate, more or less 3 cm. long, 5-7 mm. broad, flat, on both sides but especially on the upper sparingly covered with spreading bulbous-based hairs, margin thickened, distinctly undulate, fimbriate with long tubercular hairs. Racemes 2-3, distant from each other more or less 1 cm., 2 cm. long, stout, erect-patulous or finally reflexed ; rhachis subtrigonous, pilose at the base, more than twice as narrow as the spikelets slightly undulate, the angles scaberulous, otherwise glabrous, giving off solitary pedicels. Spikelets biseriate, broadly elliptic, very acute, 4 mm. long, anteriorly almost flat, posteriorly very convex, green, glabrous. Involucral glumes very unequal. Lower almost $\frac{1}{3}$ of the spikelet, subobtuse, 5-nerved, upper as long as the spikelet, very acute, distinctly 7-9-nerved. Lower floral glume equal in shape to the upper involucral glume, flat, 5-nerved, glabrous on the back, tubercular-echinulate near the margin, except near the tip and base, paleate. Upper floral glume shorter than the preceding glumes, elliptic with a rounded tip, rigid, opaque, brown-straw-coloured, rugulose, long caudate, 5-nerved, bullate below.

Locality : S. M. Country and N. Kanara (A. P. Young ex Henrard). We have not seen the specimen.

Distribution : So far endemic.

Note : Henrard has a variety from the same localities : var. *Velutina* which differs from the type by the densely pubescent spikelets. What we said in a note under the previous species can be applied here.

4. **Urochloa Helopus**, Stapf in Prain Fl. Trop. Afr. ix, 595 ; Haines in Bot. Bihar & Orissa 1002.—*U. pubescens*, Kunth Rev. Gram. i, 31, Enum. Pl. i, 74.—*U. panicoides*, Schult. Mant. ii, 595 (*non* Beauv.).—*Panicum Helopus*, Trin. in Spreng. Neue Entdeck. ii, 84 ; Panic. Gen. 150, *et* Gram. Ic. *et* Descr. ii, t. 183 ; Nees Agrost. Bras. 117 ; Steud. Syn. Pl. Glum. i, 57 ; Duthie List Grass. N. W. Ind. 4, Fodd. Grass. N. Ind. 8.—*P. Helopus* var. *glabrescens*, K. Schum. in Engl. Pfl. Ost.—Afr. C. 101 ; Stapf in Dyer Fl. Cap. vii, 392.—*P. hirsutum*, Koen. ex Roxb. Fl. Ind, i, 300.—*P. Kœnigii*, Spreng. Syst. i, 311.—*P. hochstetterianum*, A. Rich. Tent. Fl. Abyss. ii, 369.—*P. geminatum*, Hochst. ex A. Rich. l.c. (*non* Forsk.).—*P. controversum*, Steud. Syn. Pl.

Glum. i, 60; Schweinf. in Bull. Herb. Boiss. II, ii, 19.—*Setaria*? *hirsuta*, Kunth Rev. Gram. i, 47, Enum. Pl. i, 157.—*S pilifera*, Spreng. Syst. iv, Cur. Post. 33.—*Panicum javanicum*, Hook. f. in F.B.I. vii, 35 (*non* Poir, *partim*); Cke. ii, 933 (*partim*).

This is the species which was described by Hook. f. and many others, amongst them by Cooke, under the name of *Panicum javanicum*, Poir. According to Stapf *P. javanicum*, frequently confused with *U. Helopus*, is *U. panicoides*, Beauv., a distinct species. A number of synonyms and references have, according to the same authority, to be excluded from the F.B I. under *Panicum javanicum* : Bentham's Flora of Australia (vii, 476) mentions *Panicum Helopus*, but it is partly *Brachiaria notochtona*, Stapf (*Panicum notochtonum*, Domin) and partly *Brachiaria ramosa*, Stapf. T. 7 in Duthie's Fodd. Grass. does not represent *Panicum Helopus*, but *Brachiaria ramosa*, Stapf. *Urochloa panicoides*, Beauv. is a synonym of *Panicum javanicum*, Poir. *P. trichopus*, Hochst. is *Urochloa trichopus*, Stapf.

As a number of foreign elements have crept into the usual descriptions of our species we give Stapf's description of *P. Helopus*.

Annual. Stems tufted, 30–60 cm. high, erect or geniculately ascending from a short sometimes rooting base, frequently sparingly branched from the lower nodes, 4–10-noded, intermediate internodes like the uppermost (peduncle) very sparingly pubescent or almost glabrous. Leaf-blades lanceolate to linear-lanceolate from a wider and semi-amplexicaul base, 3·5–15 cm. by 8–12 mm. rarely up to 25 cm. and then linear and narrowed towards the base, soft, flat, pale or yellowish-green, loosely and often finely hirsute with tubercle-based hairs, rarely almost glabrous, margins usually crisped or wavy and more or less ciliate. Sheaths somewhat loose, pale, striate, densely ciliate upwards, more or less shortly hirsute with the hairs tubercle-based, nodes pubescent to subvillous. Ligules a densely ciliate rim. Inflorescence of mostly 4–7 erect or at length more or less spreading stiff or slightly flexuous sessile or subsessile spiciform secund racemes ; common axis 1·2–5 (rarely 7·5 cm.) long, subsemiterete below, much flattened upwards, pubescent. Racemes moderately dense, 2-seriate, simple, 2·5–5 cm. long, solitary or here and there approximate and then unevenly distributed ; rhachis straight or slightly wavy, flat on the back, about 1 mm. wide, villous at the base, glabrous upwards, rarely sparingly hairy, angles scabrid ; internodes up to 1 mm. long ; pedicels solitary, reduced to short stout stumps with discoid tips, frequently bearing some long spreading hairs. Spikelets laterally contiguous or subcontiguous ovate to elliptic-oblong, very acute, 4–5 mm. long, greenish, glabrous or pubescent. Involucral glumes dissimilar ; lower broad-ovate, subobtuse to acute, clasping at the base, 1·5–2 mm. long, glabrous or sparingly and minutely pubescent, 5-nerved upper one corresponding in size and outline to the spikelet, prominently 7–11-(mostly 9-) nerved, glabrous or pubescent. Lower floral glume very similar to the upper involucral glume, but flat or slightly depressed, 5–7-nerved with the inner side-nerves distant, glabrous or pubescent, pale oblong, acute, slightly shorter than its glume. Anthers 2 mm. long. Upper floral glume rotundate-elliptic, greenish to pale brown, 2·5–3 mm. long, pale finely transversely rugose or granular, mucro up to 1 mm. long, sparingly barbellate. Grain rotundate-elliptic on outline, much compressed, about 2 mm. long, yellowish or greenish.

Locality : *Gujarat* : Baroda (Cooke *teste* Cooke).—*Deccan* : Katraj Ghat, 11 miles S. E. of Poona (Shevade !) ; Poona (Woodrow !) ; Deolali (Blatter A110 !) ; Ganeshkhind Bot. Gardens (Patwardhan !) ; Chattarshinji (Bhide !) ; Mangiri, near Poona (Gammie 15344 !) ; Akola (Mamlatdar of Akola !) ; Dapuri near Poona (Jacquemont 482 !).—*S. M. Country* : Dharwar, elevation 2,500 ft., rainfall 35 inches (Sedgwick 2157 !) ; Kilgerry (Talbot 2419 !) ; Haveri (Talbot 2284 !) ; Bijapur (Meebold 11201 !) ; Badami (Woodrow *teste* Cooke).—*Kanara* : Kulgi, elevation 2,000 ft. (Talbot 2283 !) ; Nundgod (Mamratdar of Nundgod).

Distribution : Plains of India, Ceylon, tropical and S. Africa, Mauritius.

49. ECHINOCHLOA, Beauv. Agrost. 53, t. 11, fig. 2 ; Stapf in Prain Fl. Trop. Afr. ix, 604.

Annual or perennial. Leaf-blades from a slightly constricted or equally wide rarely much attenuated base. Ligules 0 or represented by a transverse fringe of hairs. Panicles of crowded or loosely arranged secund speciform branches

mostly bearing spikelets from the base or near it. Spikelets ovate to elliptic- or lanceolate-oblong, usually cuspidate or awned, very convex on the back, flat or slightly depressed in front, falling entire from the pedicels, 2-nate or clustered, secund and abaxial on the triquetrous rhachis of racemosely arranged false spikes Involucral glumes unequal, membranous, the lower much shorter, more or less ovate from a clasping base, 3-5-nerved, often mucronate, the upper corresponding in length and outline to the spikelet (as seen from the back), very concave, 5-7-nerved, acute, cuspidulate or cuspidate, rarely produced into a short awn. Lower floret equalling the upper glume (excluding cusps or awns) ; lower floral glume very similar to the upper involucral glume, but flat or depressed on the back and often with a more pronounced cusp or an awn ; pale equal to the body of the valve, or in barren florets more or less reduced, hyaline, finely 2-keeled. Upper floral glume ovate to elliptic-oblong, apiculate or obtuse, very convex on the back, subcoriaceous or crustaceous, polished, faintly 5-nerved, margins firm, involute up to near the tip, then flat, not embracing the tip of the pale, pale sub-equal to the glume and similar in substance, with rounded keels and flaps which thin out towards the flat slightly recurved tips. Lodicules 2, cuneate, fleshy. Stamens 3. Styles distinct ; stigmas plumose, exserted from near the tips. Grain broad-elliptic dorsally flat, ventrally convex ; hilum punctiform, subbasal.

Species about 20-25.—The warm regions of both hemispheres.

Note : It will be useful to remember what Stapf says regarding this genus l.c. 605 : ' The segregation of the numerous forms which make up the genus *Echinochloa* and their reduction to more or less well definable species is still unsatisfactory, mainly owing to their apparently endless variability and the difficulty, if not impossibility, of discriminating between stable and unstable modifications and the effects of hybridization. Here, as in other cases, observation in the field and experiment will have to decide.'

Cooke describes under *Panicum* 2 species which have to be referred to *Echinochloa : P. colonum* and *P. stagninum*. We add *E. Crus-Galli* which Cooke thought did not occur anywhere in the Bombay Presidency.

I. Lower involucral glume and upper floral glume equally acute or cuspidate ... 1. *E. colona.*

II. Lower involucral glume and upper floral glume cuspidate or produced into an awn, the latter more than the former.

1. Ligule 0 ... ... 2. *E. Crus-Galli.*
2. Ligule a fringe of stiff hairs or absent in the uppermost leaves ... ... 3. *E. stagnina.*

1. **Echinochloa colona**, Link Hort. Berol. ii, 209 ; Parl. Pl. Nov. 40 ; Hitchc. in Gray Man. Bot. ed. 7, 118. *et* in Contrib. U. S. Nat. Herb. xii, 213, xvii, 256, xviii, 345 ; Stapf in Prain Fl. Trop. Afr. ix, 607 ; Haines in Bot. Bihar & Orissa 997.—*E. zonalis*, Parl. Pl. Panorm. i, 119.—*Panicum colonum*, Linn. Syst. Veg. ed. 10 (1759), 870, Sp. Pl. ed. ii, 84 ; Jacq Eclog. Gram. t. 32 ; Roxb. Fl. Ind, i, 299 ; Nees Agrost. Bras. 119 ; Steud Syn. Pl. Glum. i, 46 ; Benth. Fl. Hongk. 411, *et* Fl. Austral. vii, 478 ; Griseb. Fl. Brit. W. Ind. 545 ; Baker Fl. Maurit, 438 ; Duthie List Grass, N. W. Ind. 3, Indig. Fodd, Grass. t. 4, Fodd. Grass. N. Ind. 4 ; Boiss. Fl. Or. v 435 ; Balf. f. Bot. Socotra 310 ; Hack. in Bol. Soc. Brot. vi, 140 ; Schweinf. in Bull. Herb. Boiss. ii, App. ii, 20, 95 ; Hook. f. in F.B.I. vii, 32 ; Cke. ii, 931.—*P. arabicum*, Nees ex Steud. Nomencl. ed. ii, 252, *et* Syn. Pl. Glum. i, 63 (*partim*).—*P. brizoides*, Linn. Mant. ii, 184.—*P. tetrastichon*, Forsk. Fl. Aegypt.—Arab. 19.—*P. cuspidatum*, Roxb. Fl. Ind. i, 301 ; Duthie Grass. N. W. Ind. 3 ; Steud. l. c. 47.—*P. pseudocolonum*, Roth. Nov. Sp. 47; Steud. l.c. 46.—*P. zonale*, Guss. Ind. Sem. H.R. Bocc. 1825, *et* Fl. Sic. Prodr. i, 82.—*P. numidianum*, Presl. Cyp. & Gram. Sic. 19 (*non* Lam.).—*P. Daltoni*, Parl. ex Webb in Hooker Niger Fl. 185.—*P. equitans*, Hochst. ex A. Rich. Tent. Fl. Abyss. ii, 365.—*P. Crus-Galli* var. *colonus*, Coss. Glum. Expl. Alger. 28.—*P. Petiveri*, Kotsch. ex Griseb. l.c. (*non* Trin.).

Description : Cke. ii, 931.

Locality : *Sind* : Karachi (Nankad !); Mirpurkhas (Bhide !, Sabnis B1176 !) ; Sind (Blatter !) ; Larkana, barren plains (Sabnis B93 !, B95 !, B457 !) ; Sanghar (Sabnis B899 !, B894 !) ; Nasarpur, clayey soil (Sabnis B1048 !) ; Mirva Canal, Khairpur Mirs (Sabnis B263 !) ; Khairpur Mirs (Sabnis B337 !) ; Sehwan to

Laki (Sabnis B63 !) ; Hyderabad (Sabnis B49 !) ; Pad-Idan (Sabnis B516 !) ; Chuar Ch. (Blatter & McCann D616 !, D621 !) ; Baghar (Blatter & McCann D617 !) ; Mirpur Sakro (Blatter & McCann D618 !, D620 !) ; Ghulamalla (Blatter & McCann D619) ; Shikarpur (Woodrow).—*Gujarat* : Lasundra (Chibber !) ; Anjor (Cutch), brackish water (Blatter 3743 !) ; Ahmedabad (Cowper !) ; Morvi, Kathiawar (Woodrow).—*Khandesh* : Muravad, Tapti bank (Blatter & Hallberg 4435 !) ; Bor, Tapti Island (Blatter & Hallberg 4439 !); Dadgaum (McCann A104 !) ; N. slope of Chanseli (McCann A105 !).— *Konkan :* Bombay, salt swamps (Woodrow !) ; Vetora (Sabnis 33589 !) ; Charni Road, Bombay (Sabnis 4292!) ; Bombay, very common (McCann!); Alibag, rice fields (Ezekiel!).— *Deccan :* Purandhar Fort (Bhide !, McCann 5520 !); Nira Canal, Poona District (Chibber !); Khandala, very common (McCann A101 !); Sholapur (D'Almeida A102!); Igatpuri (Blatter & Hallberg 5487 ! ; McCann 4331!); Deolali (Blatter A103!); Poona, canal (Ezekiel !).—*S. M. Country* : Dharwar (Sedgwick 2655!) ; Castle Rock (McCann A106!); Londa (Woodrow).—*Kanara* : Dongi Nallah (Talbot !); Karwar (Talbot 614!).

Distribution : Throughout the plains of India, Ceylon, all over the tropics and the warm-temperate regions of the world. Probably of African and Indian origin according to Stapf.

The same author is of opinion that *Panicum frumentaceum*, Roxb. which is grown in India as a grain crop, is evidently descended from *Echinochloa colona*. Roxburgh's species may, therefore, be treated as a variety :

var. frumentacea, Blatter & McCann.—*Echinochloa frumentacea*, Link. Hort. Berol. i, 204 ; Aitchis. Cat. Panjab Pl. 161.—*Panicum frumentaceum*, Roxb. Fl. Ind. i, 304 ; Schult. Mant ii, 230 ; Trin. Sp. Gram. Ic. t. 164 ; Duthie Grass. N. W Ind. 4, Field & Gard. Crops 3. t. 24, Fodd. Grass. N. Ind. 8.—*P. Crus-Galli*, var. *frumentaceum*, Trim. Cat. Ceyl. Pl. (1885), 104.—*Echinochloa Crus-Galli*, var. *frumentacea*, Haines in Bot. Bihar & Orissa 998.—*Panicum stagninum*, Retz. var. *frumentacea*, Cooke in Cke. ii, 931.—*Oplismenus frumentaceus*, Kunth Rev. Gram. i, 45, Enum. Pl. i, 146 ; Dalz. & Gibs. Bomb. Fl. Suppl. 98.

Description : Tall, robust. Stems erect, from 60 to 120 cm. high. Panicle often nodding. Spikes secund, incurved, crowded. Spikelets mostly 3-nate, unequally pedicelled, one at least sessile, varying from hispidulous to almost glabrous, and from acute to cuspidulate or rarely distinctly cuspidate.

Locality : Cultivated in and near the Ghat districts.

2. **Echinochloa Crus-Galli**, P. Beauv. Agrost. 161 ; T. Nees Gen. Fl. Germ. Monocot. i, t. 21 ; Reichenb. Ic. Fl. Germ. i, t. 29, fig. 1411, 1412 ; Hitchc. in Contr. U.S. Nat. Herb. xii, 213 ; Stapf in Prain Fl. Trop. Afr. ix, 610 ; Haines in Bot. Bihar & Orissa, 998.—*E. commutata*, Schult. Mant. ii, 267.—*E. hispidula*, Nees in Royle Ill. Bot. Himal. 416 ; Dalz. & Gibs. Fl. Bomb. Suppl. 98.—*Panicum Crus-Galli*, Linn. Sp. Pl. ed. i, 56 ; Fl. Dan. t. 1564 ; Host. Gram. Austr. ii, 15, t. 19 ; Knapp Gram. Brit. xi, Trin. Sp. Gram. Ic. t. 161, 162 ; Nees Fl. Afr. Austr. 58 ; Steud. Syn. Pl. Glum. i, 47 ; Benth. Fl. Austr. vii, 479 (*partim*) ; Duthie List. Grass. N.W. Ind. 3 (*partim*) t. A. fig. 1; Boiss. Fl. Or. v, 435 ; Hook. f. in F.B.I. vii, 30 (*partim*) ; Stapf in Dyer Fl. Cap. vii, 397.—*P. hispidum*, Forst. Prodr. 7 ; Nees Agrost. Bras. 257.—*P. hispidulum*, Retz. Obs. v, 18 ; Lam. Ill. i, 171 ; Roxb. Fl. Ind. i, 306 ; Nees Fl. Afr. Austr. 57 ; Royle l. c. 420 ; Steud. Syn. Pl. Glum. i, 47.—*P. oryzinum*, Gmel. Syst. i, 157.—*P. stagninum*, Host. Gram. Austr. iii, t. 51 (*non* Retz.).—*P. Hostii*, Marsch. Bieberst. Fl. Tauro-Cauc. iii, 57.—*P. limosum*, Presl ex Nees Agrost. Bras. 257.—*Milium Crus-Galli*, Moench Meth. 202.—*Oplismenus Crus-Galli*, Dumort. Agrost. Belg. ; Kunth Rev. Gram. i, 44, *et* Enum. i, 143 (*excl. syn. P. zonale*).—*O. limosus*, Presl., Rel. Haenk. i, 321 : Kunth Enum. i, 144.—*Orthopogon Crus-Galli*, Spreng. Syst. i, 307.—*O. Retzii*, Spreng. l.c.

Description : Annual, up to 1 m. high. Stems geniculately ascending, branched below, compressed towards the base, glabrous and smooth, internodes enclosed or exserted. Leaf-blades linear, base scarcely narrowed, narrowed to an acute point, 7-25 cm. by 6- over 12 mm., flat, subflaccid, glabrous, more or less dull greyish-green, smooth or scaberulous below, particularly towards the tip, margins finely cartilaginous, scabrid to almost smooth. Sheaths somewhat loose, the lower often compressed, whitish and

thin, the upper subherbaceous, all smooth, glabrous and striate except the basal which are pubescent above their insertion. Ligules 0, junction of blade and sheath glabrous inside marked by a brown zone. Panicles erect, strict or flexuous, at length exserted, 7·5–20 cm. long; axis triquetrous, scabrid; branches few to about 15, solitary or 2-nate, suberect or spreading, distant except the uppermost or all more or less approximate forming a 'lobed' panicle, the lower 2·5-6·2 cm. long, forming rather stout dense mostly many-ranked simple or subcomposite subsecund sessile false spikes; rhachis triquetrous, scabrid, coarsely bristly, particularly near the nodes; pedicels fascicled or 2-nate, very short, up to 1 mm. long, scabrid, bristly at the base, tips subdiscoid. Spikelets crowded, ovate-elliptic in outline, acute, cuspidate or awned 2·5-3 mm. long, greenish or tinged with purple. Lower involucral glume membranous, very broadly ovate, clasping at the base, obtuse to subcuspidate, 1 mm. long, 5-nerved scaberulous; upper herbaceous-membranous, very broadly ovate-oblong, concave, acute, cuspidate, as long as the spikelet, 5- or (near the tip) 7-nerved, rigidly pubescent between the scabrid and spinulose nerves. Lower floral glume similar to the upper involucral glume, but flat or depressed on the back, cuspidate or produced into a scabrid often long flexuous awn, 7-nerved (at least at the tip), pale elliptic, shorter by ¼ than its glume, keels scaberulous upwards; upper floret hermaphrodite, elliptic-ovate in outline, cuspidate, over 2 mm. long, whitish or yellowish, polished, glume and pale subcoriaceous. Anthers oblong. Grain broad-elliptic in outline, 1·5 mm. long.

Locality: *Sind*: Mirpurkhas (Bhide!); Ghulamalla (Blatter & McCann D613!); Keti (Blatter & McCann D614!).—*Gujarat*: Stream near Prantij (Sedgwick!); the Bokh, Prantij Taluka (Sedgwick 1144!).—*Deccan*: Poona (Woodrow!).—*S. M. Country*: Aluarar, elevation 2,000 ft., rainfall 35 inches (Sedgwick 3096!); Bidi, elevation 2,500 ft., rainfall 50 inches (Sedgwick 3076!).—*Kanara*: Halyal (Talbot 2167!).

Distribution: Common through the greater part of India and Malaya; as a weed throughout the warm temperate countries of the northern hemisphere, rather rare in the tropics of Africa and the New World and south of the Tropic of Capricorn (Stapf).

Uses: See Duthie, Fodd. Grass. N. Ind. 6; Vasey Agric. Grass. Unit. States ed. ii, 27; Maiden Man. Grass. N. S. Wales, 38-41; Yearbook U. S. Dept. Agric. (1902), 580–582.

3. **Echinochloa stagnina**, P. Beauv. Agrost. 161; Stapf in Prain Fl. Trop. Afr. 617.—*E. scabra*, Roem. & Schult. Syst. ii, 479.—*Panicum stagninum*, Retz. Obs. v, 17; Roxb. Fl. Ind. i. 295; Grah. Catal. 237; Nees Agrost. Bras. 261; Trin. Pan. Gen. 128, *et* in Mém. Acad. Pétersb. 6me sér. iii, 216; Steud. Syn. Pl. Glum. i, 47; Stapf in Dyer Fl. Cap. vii, 394; Cke. ii, 930.—*P. scabrum*, Lam. Ill. i, 171, *et* Encycl. iv. 744; Nees l. c.; Steud. l. c.—*P. Galli*, Thunb. Prodr. 18, *et* Fl. Cap. ed. i, 389, ed. Schult. 103.—*P. Crus-Galli*, Woodrow in Journ. Bomb. Nat. Hist. Soc. xiii (1901), 433 (*non* Linn.).—*P. Crus-Galli*, var. *stagninum*, Fenzl. in Ind. Sem. Hort. Berol. 1850; Hook. f. in Trim. Fl. Ceyl v, 136; Prain Beng. Pl. 1174.—*P. Crus-Galli*, vars. *maximum*, *submuticum et leiostachyum*, Franch. Contr. Fl. Congo Franc. in Bull. Soc. Hist. Nat. Autun. viii, 347.—*P. pictum*, Nees Fl. Afr. Austr. 59 (*non* Agrost. Bras.).—*P. Burgu*, A. Cheval. in Rev. Cult. Colon. vii, 513–520.—*P. Lelievrei*, A. Cheval. l.c. 516.—*P. oryzetorum*, A. Cheval. l.c.—*Orthopogon stagninus*, Spreng. Syst. i, 307.—*Oplismenus stagninus*, Kunth Rev. Gram. i, 44, *et* Enum. i, 144 (*partim*); Dalz. & Gibs. Fl. Bomb. 292.—*O. scaber*, Kunth Rev. Gram l.c. 44, Enum. l.c. 145.

Description: Cke. ii, 930, under *Panicum stagninum*.

Locality: *Sind*: Ghulamalla (Blatter & McCann D615!).—*Konkan*: Virar, on bank of a tank (McCann 9585!, 9584!).—*Deccan*: Igatpuri (Blatter & Hallberg 5473!); Khandala, in water in the smaller village tank (McCann 27441!); Panchgani (Blatter & Hallberg B1241!).—*S. M. Country*: Hulkop, elevation 2,000 ft., rainfall 50 inches (Sedgwick 3175!); Chikkerur, Taluka Kod, water hole by road (Sedgwick 1969!); Bomigatti tank (Sedgwick 3830!); common in the Carnatic (Sedgwick).—*Kanara*: Pardhani (Talbot 3136!).

Distribution: More or less throughout India, Ceylon, tropical and S. Africa.

Uses: Considering tropical African conditions Stapf observes (l.c 619): 'This grass deserves every attention on account of its locally abundant supply

and high sugar-content. Chevalier states that it is the most useful of all the plants growing in a wild state in the neighbourhood of Timbuctu. Every part of it is utilized. It yields excellent fodder, material for thatching and caulking, is burned to produce a salt used in the manufacture of soap and indigo, the grains are eaten and the canes are gathered for extracting sugar or preparing vinaigre or a beverage resembling cider. Sir John Kirk also describes it as one of the richest of fodder grasses. Although typically a perennial with long rhizomes creeping in the mud of swamps, lakes and rivers, it seems on temporarily flooded land to flower frequently the first year and then to behave as an annual.'

(*To be continued*).

A COLLECTING TRIP TO LADAK

BY

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PART II

(*With two Plates*)

(*Continued from page 517 of this Volume*)

Shushal (14,500 feet) our next halt, is a delightful spot. We had camped in a willow garden, with the ever-present 'Gompa' (monastery) perched on a hillock. We were 'pleasantly' surprised to find next morning, that a heavy fall of snow had blotted out the landscape, which was not usual for the time of the year at those altitudes, unless something was radically wrong somewhere.

Half a mile behind our camp, the Bar-headed Geese (*Anser indicus*) were breeding on a shallow 'jheel' and appeared to lay their eggs on little grass-topped islands. On our arrival there were quantities of egg-shells scattered about and only one young in down, which was secured.

It is probable that the young are preyed upon by birds of prey. The Tibetan, for a certainty will not molest these birds, believing that with the hatching out of successful broods, the year's harvest is as good as assured. They even go so far as to appoint a 'watchman', who does not seem very enthusiastic over a job that keeps him out all day, and will no doubt give any naturalist the necessary help, for a consideration, and be glad to see the last of the 'darned things'.

A suitable tip in the right quarter often got us much invaluable information on the breeding sites of Owls, Partridges and Snow-cocks, though some of the local sportsmen drew on their imagination freely and appeared quite content merely with having strolled out with a Sahib. Others again seemed overjoyed with the prospect of a morning with the guns and felt quite hurt if their lively chatter was cut into by the interpreter, with the remark 'that they should keep their reminiscences for their great-grandchildren on long winter nights'.

The Large Eagle Owl breeds among bare rocky hills, usually on the precipitous sides, in huge 'rifts'. At Shushal we secured a parent bird with two young in down. The Brahminy was also seen leaving the hillside, and in among the reeds the Mallard had changed the plumage by which we know him so well, for one quite insignificant.

Brandt's Snow Finch (*M. brandti hæmatopyga*) appeared in large flocks and as Col. Meinertzhagen observed, these were all females. The males seemed to keep to the higher altitudes, and even as late as June neither sex showed any signs of genital development.

Among the Rose Finches, *Erythrina rubicilla severtzovi* appeared the commonest along the Pangkong Lake, frequenting the most desolate regions.

Another species of Rose Finch, which roosted in hundreds on the willow trees around our camp, has been identified as a new race. Col. Meinertzhagen has named this *Erythrina rubicilloides lapersonnei* and gives the following :—

'Ladak specimens are generally paler above and below, the upper parts not washed with such a deep crimson and the under parts of a paler and more delicate rose-colour than occurs among Kansu specimens. Females are also generally paler.

'A single female was obtained at Leh on May 7 and they occurred in large numbers at Shushal in June, where many hundreds used to roost in a willow grove in which I was camped. Birds seen at Chumathang at 13,050 feet above Leh on the Indus were also believed to be of this species. They are not so shy as *E. r. severtzovi* and seem to prefer a less desolate type of country. They were busy building at Shushal in June, many incomplete nests being found in willow-trees and furze (*Caragana*) from one to twelve feet from the ground.

'Birds recorded under *Erythrina rhodochlamys* by Hume and Henderson ("Lahore to Yarkand," p. 259) and by Sharpe (Second Yarkand Mission, p. 42), are without doubt *E. rubicilloides lapersonnei*. The birds observed by Henderson at Tutyalak (13,000 feet) and recorded as *severtzovi* were more likly to be *Pyrrhospiza*, which is common there. It is not suitable country for *Erythrina rubicilla* or *rubicilloides*.'

Leaving Shushal on the 22nd June we cut across to the Indus over a mountainous pile of rocks, which leaves one with the impression that this particular part of the globe has been left unfinished by the Great Architect and the material strewn about.

We follow the hot dantesque gorges of the Indus as they wind in and out amidst the silent rocky mountains whose peaks cut a jagged line against an azure sky. Flat-topped hamlets punctuate the monotony of sun-baked rock and muddy water where the gorges open out; but such openings are few. The general aspect is that of the protracted neck of a bottle, so narrow in places, that it would not be a feat to kick one's hat across.

While on the theme, a brief hydrographical account of the upper reaches of the Indus which of recent years, political movements have made accessible, would not bore the reader more than we have done already.

The remarkable phenomena of the upper reaches of the Indus Valley are the clearness and transparency of the atmosphere and the great difference between the sun's temperature *in vacuo* and the air temperature in the shade. This difference as recorded at Leh occasionally exceeds 90°.

The sources of the Indus have been traced to the glaciers of the Kailas group of peaks and except for the remarkable instance of transverse drainage, pursues an even north-westerly course amidst an array of mountain scenery which for its majesty of sheer altitude is unmatched by any in the world.

At Leh the river has already pursued an even course of 300 miles from its source and except for the divergence which occurs about 100 miles above Leh, continues on a comparatively gentle placid course over its sandy bed, when it captures the Shyok River (a tributary almost as large as itself) and fed by the monster glaciers of the Kara-Koram Range. The combined streams still hold on a north-westerly trend for another 100 miles deep hidden under the shadows of the vast array of snow-capped mountains of Baltistan until they arrive a few miles below Gilgit. Here the great change of direction to the south-west occurs, which is thereafter maintained till the Indus reaches the ocean.

The Indus of to-day is the Indus of myth and legend but swept clean of mystery and the hidden strongholds of the fanatics along its banks—a hindrance from all time to the progress of this world.

Many important points are bridged by the suspension system, though there still exists the 'Cantilever' and the rope-bridge which sways uneasily over the roaring waters.

We dipped into Puga in Rupshu and continued up the sandy valley to the shores of the Polokonka Lake (14,000′), where we found the Great Crested Grebe (*Podiceps cristatus cristatus*) breeding, as well as a large colony of Brown-headed Gulls in an advanced stage of genital development.

The eggs of the Crested Grebe are placed on a floating mass of reeds and the eggs, 4 to 6, in number appear to take on the colour of the decaying matter in the nest.

Several lakes in the east districts at 14,000 feet above sea level have been of much greater extent and connected to the drainage system of the country, but they are now mostly without outlet, saline, and in process of desiccation.

The highest visible water mark of the Polokoncha Lake is quite 150 feet above its present level, and recent years seem to show a much more rapid process towards drying.

We shifted camp to the northern end of the lake and pitched our tents on the lawn-like banks of a mountain torrent, while all around the Poppies and Primulas grew in wild profusion.

There was comparatively little of bird or animal life. Guldenstadt's Redstart (*Phœnicurus erythrogastra grandis*) seemed in sole possession of the stream. The surrounding hills offered nothing but bareness and desolation.

Small parties of Wild Asses, or Kiangs as they are more commonly known, visited the shores of the lake in the early mornings and late evenings, the dead stillness being occasionally broken by their 'shrieking bray.' There seems a good bit of discrepancy between the accounts of the Kiang's cry given by different sportsmen. We could safely leave it as intermediate between the neigh of a horse and the bray of an ass—almost alike to the vocal efforts of a mule, which at its very best sounds like nothing on earth.

Whether in the rarified atmosphere the Kiang is as fleet of foot as the species from Sind, it is difficult to say. The former can 'move' on occasions taking 18,000 and 19,000 feet hills in grand style.

Besides its dreariness, the shores of the Polokoncha hold for the



THE ROCKY ROAD TO YARKAND



traveller a certain sadness. It was here that the wife of a young Englishman met a tragic end, by inadvertently lighting a fire in her tent with the very obvious result, when the very first rule in camping is broken.

On the 28th June we left the Polokoncha Lake and crossing the Taklung Pass (17,600 feet) which rises sheer from the shores of the lake, descended rather abruptly into the Gya Gorge.

While on the Taklung Pass the writer brought off a record bag of Snow-cock (*Tetraogallus tibetanus*) obtaining six birds in a single shot! The possibility of such a feat may be enhanced when it is known that two adult birds had their heads together, while four young squatted on the mother bird's back.

Following the Gya Gorge, which with rare determination pierces an arm of the Ladak range, we swing off to right angles and enter once again the Indus Valley which still keeps its boulder-strewn nature. You wonder if the track lost itself or from fright and loneliness ran up a frightfully untidy glen to Hemis, or that Hemis huddled itself among the bare rocky crags in trying to escape from the encroachments of 'western civilization', for even here the missionary offers a very very old dog a new collar, expecting him to do new tricks.

We wind up the frightfully untidy glen into the heart of the mountains, where amid forbidding rocky hills, Hemis, the Mecca of one of the noblest of religious faiths and simple philosophies yet unfolded by man, stands gaunt and silent.

True to this land of contradictions and surprises, a delightful garden of stately poplars and wild roses, whose delicate perfume scented the balmy air, was cradled among the barren hills and set like a first-water jewel in a cheap trinket. A multi-coloured crowd of Ladakis thronged the massive gates that led into the monastery; while taking his joys less seriously, that hardy son of desolate wind-swept steppes, the Tibetan, could easily be picked out by his easy swinging walk and his fine example of full-blooded manhood. From the babble of voices it seemed that all Ladak and his wife had turned up to witness the annual Devil-dancing and Festival held at Hemis. And so the sun set on this strange scene, casting grotesque figures among the crags, until night shrouded the narrow glen in a sombre mantle, the darkness punctuated with innumerable camp fires.

It might have been a scene from the Arabian Nights, if such a scene did not date back to 500 B.C., for Hemis is almost as old as the hills, even older some say.

The religious displays or 'Devil-dances' enacted annually among the Bhuddists are familiar sights anywhere between Ladak and Bhutan.

Much has been written on the various conceptions of this mystic religion. Mystic, perhaps from the theologist point of view but to the weary traveller it appears a bewildering agglomeration of superstitions pieced together into an amazing farce, in which the 'Sons of Belial have a glorious time'.

Still one is really impressed by the rhythmic dancing, the gorgeous dresses and the grotesque masks worn by the dancers,

which vie with each other in diabolic hideousness. Then, too, there is the perfect symphony produced by the treble and bass trumpets. The latter are ten feet in length and emit a volume of sound not unlike the amplified drone of a giant beetle in flight.

We left Hemis and arrived at Leh, by two easy stages on July 5th. As yet the status of many of the migrants had not been cleared up and the few days spent at Leh in preparations for our journey to the Karakoram were helpful in clearing up one or two problems. The Blue-throats (*Luscinia svecica* ssp.) which seem fairly well distributed along the Indus and Shyok Rivers, wherever suitable country is found, have for a considerable time confused naturalists by their variable colourings on the throat.

Thanks to Col. Meinertzhagen's systematic methods of collecting, we obtained a remarkable fine series of the Blue-throat which breeds in Ladak. This has been identified as *Luscinia svecica abbotti*, and is characterized by a variable colouring of red, sometimes reddish-white and white stars. Among our specimens of *Luscinia suecica abbotti* there were five males and one female with pure white stars, four males with pure red stars and four males and two females a mixed red and white.

A red 'starred' male would have a white 'starred' female or *vice versa*. The type is a white-starred bird, and is known as the 'White-spotted Blue-throat.'

Next we have *Luscinia suecica pallidogularis* (the Red-spotted Blue-throat) which oftener than not is mistaken for the preceding bird. Of *pallidogularis* Col. Meinertzhagen says, 'Whereas in *abbotti* the "star" is very variable, in this race it is always pure red, sometimes a few white feathers are apparent. Underparts paler than in *abbotti* and with seldom much black at the lower end of the blue chest. Blue much paler. This is the only Blue-throat met with in Kashmir in spring. First arrivals (all males) were noted on March 23. This race does not breed (nor does any Blue-throat) in the Vale of Kashmir, though in Northern Kashmir, on the Gilgit Road at 11,300 feet I found two pairs feeding young. The adults are typical of this race.'

Thus we have *Luscinia* (*Cyanosylvia*) *suecica abbotti* breeding throughout the Indus and Nubra Valleys—but not in Baltistan; and *L. s. pallidogularis* breeding in Baltistan (Western Turkestan to East Trans-caspia—Hartert).

These observations are clear enough and backed with specimens, and should eliminate the difficulty in identifying the Blue-throats.

With the advent of spring the dreariness of winter seems never to have existed. It is a country of sunshine and rivers and rich fertile valleys; and far away the great mountains hang in the serene sky, peaks, crests, and ridges of inaccessible and eternal snow.

The little hamlets in the sweep of the Indus Valley peep through a smothering foliage of poplar and willow; while the cheerful chatter of the House Sparrows adds liveliness to the drowsy air.

It is surprising that the Jackdaw (*Corvus monedula sœmmeringii*), so abundant in the Vale of Kashmir, should not find its way up here (Leh). Beyond a couple seen in Leh in May we never came across

these birds anywhere in Ladak. Surely there is some mistake in Baker's statement [1] that these birds breed in Ladak!

Nor does the Jungle Crow (*Corvus coronoides intermedius*) extend for any great distance into Ladak, though this bird has been recorded as breeding in Ladak. What may have been mistaken for the preceding bird is the Carrion Crow (*Corvus corone orientalis*), which we found quite plentiful at Kargil in April and took several clutches of eggs from nests in willow trees at Moulbeck (11,000 ft).

Elsewhere I have mentioned the House Crow (*C. s. zugmeyeri*) as occurring in the Vale of Kashmir, and then only being isolated to a few colonies, which Osmaston observes do not leave the valley but brave the winter. Perhaps it may yet be discovered that the Sind House Crow and the one in Kashmir may not belong to the same race.

If there is a paradox among birds it is the scavenger of Ladak—the Tibetan Raven (*Corvus corax tibetanus*). To see him studiously peer into the bowels of a dead horse or walk gingerly in the refuse of a village is to heartily dislike the fellow; but to see him at 'play' is truly amazing. They wanton about in a thousand different manners and postures, sometimes pursuing each other, and making a mock fight; sometimes rising; sometimes falling with closed wings; sometimes floating a while in the air on their backs; sometimes flying edgewise; sometimes whirling round the monastery with vast rapidity; and all with an eagerness and joyousness of motions and cries and screams that showed the overflowings of happy sensations too plainly to be mistaken. Besides these attractions, *C. c. tibetanus* has a 'most peculiar and extraordinary metallic call wondrously like the tones of bells which emitted from a hill-top has the resemblance to "vesper bells" heard at a distance.'

He also possesses a sense of humour. Observe his comical imitations of an eagle missing its prey. He will sit calmly by and watch the fruitless efforts of an eagle or buzzard, and then with twirls and turns and screams will show you how it shouldn't be done. But we digress. Our preparations are almost complete for the trip to the Karakoram. A slight change has occurred in our *dramatis personæ*. The shikari's abhorrence for the cook and his ancestors finds a head and he gives vent to his pent-up feelings. Feelings which, he confides in me, he has fostered ever since he clapped eyes on the son of Sheitan. And, like all true Muslims who at least a dozen times a day 'seek refuge in Allah from Sheitan the stoned', he had no alternative but to resign.

Unfortunately this '*batailleroyale*' took place on a plateau at 16,600 feet, where the only Tibetan Grouse (*Syrrhaptes tibetanus*) we had seen, was secured. Our skinning after the day's march prevented either of us from a thorough search for more specimens. The incident will prove the effects of high altitude on the equanimity of the mind, of even those of little or no imagination.

The vacancy was soon filled up by a Yarkandi—a fellow who could go over a pass without a sob and be game for some more! His is

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[1] F. B. I. vol. i, page 36.

the type one meets along a line drawn from Yarkand, through Afghanistan and Baluchistan, along the highlands of Persia, into Kurdistan and so to Turkey ; and like the soldier of that country, he will fight or freeze, march and starve not only without a mutiny but even without a sense of grievance against anybody. He is a gentleman, and anyone acquainted with Muslim countries knows that a Moslem gentleman is unsurpassed in any country.

We left Leh on July 12, and camped that evening just below the Kardong Pass at 15,000 feet. Next morning a diligent search was made for that beautiful Rose-finch (*Pyrrospiza punicea humii*) of which Col. Meinertzhagen secured one the evening we arrived. I had marched up a side valley to the foot of a glacier and drawn a blank and then up a rugged hill to about 16,000 feet, where, pausing from the effects of an oppressive atmosphere I looked back to where Leh lay basking in the noonday sun, and then for no apparent reason an unmitigated slab of dreariness came over me and I wished Leh, Ladak, the snowy mountains and all naturalists in the nether regions. High altitude again ! If such feelings are allowed to run riot anything may happen ; but I had an employer who understood better than I then thought and shall always feel grateful to him for his tolerant attitude towards my misgivings. It is but human nature that we consider our own experiences in travel and adventure as unique (with special stress on the hardships), and completely ignore the fact that others have been before us and others will follow.

If you have crossed the Great Himalayas in winter and wandered through barren Ladak ; if you have crossed the Changla Pass at 18,500 feet and found another pass still higher, and your goal is a desolate region which is called Chang-chen-mo ;—if these trifling hardships damp your enthusiasm there is a quiet garden in Leh among the tall silent poplars, with the wild roses rambling over the swelling sod, that marks the trend of those pioneers who have ' gone before ;' it will make you ' gird up your loins ' for yet another try.

Here among the lone graves, an obelisk is raised by a thankful Government as a small mark of its appreciation to the memory of Ferdinand Stoliczka, that brilliant young scientist who gave of his best in that bloodless field of Natural History.

' Ferdinand Stoliczka,' so the inscription runs, ' the eminent young Geologist and Natural Historian accompanied the second Yarkand Mission in 1873 under Sir Douglas Forsyth. His health, severely affected by his previous work, gave way under the strain of strenuous work, he died at Shyok, in June 1874, ' while returning loaded with the spoils and notes of nearly a year's research in the least known parts of Central Asia.'

' The scientific results of this research,' writes Allen Hume, ' constitute an imperfect record of one single year's work of our dear friend and comrade Ferdinand Stoliczka. Imperfect,—because we had only his collections and a very brief diary—a mere *aide memoire* to work upon and so are able to present only the dry bones, as it were, of the results of his labours ; which had he survived to deal with them himself, would have risen up a living entity, vivified by his genius.

Imperfect,—but yet the best memorial that, under the circum-



Stoliczka's Tomb, Leh.

stances, we survivors could raise to him, untimely hidden in that lone Tibetan grave.

Imperfect,—but for all that, affording every here and there glimpses of the perseverance and self-devotion which, informed by wide scientific knowledge, and sanctified by a pure and generous heart, constituted Stoliczka's irresistible claims to respect the admiration and the love of all who ever came closely in contact with him.'

To those who are acquainted with the Palaearctic, that cruel relentless region, Stoliczka's name shall go down as one of those heroes whose bloodless blameless triumphs remain for ever the inheritance and the blessing of mankind.

The road after crossing the Kardong Pass at 17,600 feet descends abruptly into the sandy valley of the Nubra River. So abrupt was the snow-covered descent that we expressed a wish we would never have to assault this particular pass again. Fruitless wish!

The Nubra Valley, unlike the Indus, is fairly well cultivated—its entire length being more or less planted with large gardens and the gaps filled up with tamarisk bushes.

Panamik, 10,400 feet is the last village below the Karakoram. From here the road turns into the Nubra Gorge and follows the roaring river along its precipitous banks till an altitude of 13,000 feet is reached and then takes one on to a meadow, surrounded by stupendous mountains, with gigantic glaciers between the peaks.

The Karakoram Range forms the great water divide which separates the Indus drainage from that of the Yarkand and other Chinese-Tibetan rivers.

It is buttressed by K^2 (Godwin-Austen) 28,650 feet at its convergence with the undulating elevated plateau of Yarkand. The accompanying photograph gives some idea of the mountainous regions and two enormous glaciers are clearly seen on either side of the conical hill.

The pass over this range is crossed over a ten-mile glacier at 19,000 feet and lets one into Yarkand.

The snow had melted, only the very highest peaks retained their winter mantle, and the glaciers sparkled in the bright sunshine, and as the ice thaws huge boulders clatter down. The pass itself winds up the debris brought down by the melting of snow and ice, and, taken all round is the most savage bit of primeval chaos in all the mountain ranges we encountered.

Perhaps our protracted stay at high altitudes had weakened us physically or perhaps this was our Pisgah, but after a 'trial' up the slippery moraine, Col. Meinertzhagen decided to turn back and we began the return journey as eagerly as horses heading for stables.

It was Col. Meinertzhagen's intention to work the Shyok Valley up to its junction with the Indus and crossing over thence to reach Skardu. But this project had to be abandoned owing to the floods in some of the rivers.

We will not weary the reader with a description of the return journey to Leh.

Let it suffice that as we confronted the steep ascent to the

Kardong Pass, nothing in the vocabulary could express my feelings. It was the first pass wherein I lay hold of a Yak's tail as a means of locomotion and was hauled, much against my will, at a pace which caused alarming palpitations.

Skardu, which will be found upon the map, is the capital of Baltistan (or Little Tibet as it is called), and rests amidst a fine array of rugged mountains with the Indus sweeping past in a great horse-shoe bend. We arrived here on August 13 after a hot trip through the Indus Gorge, to find Skardu among one of the dirtiest towns in the Himalayas. The inhabitants, originally Bhuddists, are now extremely bad imitations of Moslems, and like all proselytes are heartily disliked by both sides. However, Baltistan amply repays a visit. Its bird-life will settle many a knotty problem, being a sort of half-way house between Kashmir and the desolate regions that lie beyond Baltistan.

Most of the migrants were undergoing their autumn moult prior to setting forth on their winter passage, during our visit.

Conspicuous among these was that familiar little fellow, the Kashmir Red-start (*Phœnicurus ochrurus phœnicuroides*), who seemed to be fairly well distributed throughout Ladak also. The Eastern Red-spotted Bluethroat (*Cyanosylvia suecica pallidogularis*) were busy feeding young, as were the Pied Chats (*Œnanthe picata*).

The Hoopoes (*Upupa epops*) were in fresh plumage and ready to take off. These are distributed throughout Ladak and are found always near villages. The regularity of their arrival from the plains to their breeding haunts in Ladak has fixed the date for the commencement of spring ploughing in that country.

Cholera had been raging on Skardu on our arrival and we were glad to get a move on. On August 19 we left Skardu for the Deosai Plateau by way of the Satpur Lake, which is cradled between two rugged hills, quite 5,000 feet above Skardu, and worried our way up to 11,500 feet when we sat down for tiffin.

Up to this stage Col. Meinertzhagen had shown no sign of the catastrophe which befell him. We had even secured a new sub-species of the Twite (*Acanthis flavirostris baltistanicus*), as distinct from *Acanthis flavirostris ladacensis*, which is also a new sub-species.

That same afternoon, while we camped at about 13,000 feet, Col. Meinertzhagen had an attack of cholera and to add to this misfortune a snow storm swept down the hill.

Next morning we crossed over at 14,000 feet and the Deosai Plateau stretched away from our feet to the lilac hills, over an even grassy meadow, strewn with flowers. It was a relief being able to see such an expanse of open country after months of confined valleys and dreadful gorges. To see the sun set without intervening mountains or the golden orb of the moon rise over the rim of the world.

Even though the cholera still gripped him, Col. Meinertzhagen kept the same cheerfulness and keen interest he had always shown.

The plateau for the most part was well stocked with higher altitude birds. The Horned Larks were abundant and Col. Meinertzhagen

has separated these from *Otocoris alpestris longirostris* and named them *Octocris* (*Eremophila*) *alpestris deosai*. In the *Ibis* (1927, p. 402) he says: 'A series of nine birds were obtained on the Deosai Plateau at the end of August. They are mostly in full moult, only three birds having completed their wing moult, (wings of three 127-131, culmens of six males 18-20 m.)

These birds run as large as *longirostis* but are both darker and browner in fresh plumage. They have the white gap between the black of the throat and that of the cheeks.

Apparently confined to the Deosai plateau between 12,000 and 14,000 feet.'

The Robin Hedge-Sparrow (*Prunella rubeculoides*) which was commonly met with between 12,000 and 14,000 feet over the greater part of Ladak was abundant on the plateau, and several nests were seen with fresh eggs on July 8. Col. Meinertzhagen has separated this form under *P. r. muraria*. We crossed the plateau in three marching days; owing to Col. Meinertzhagen's condition matters had to be rushed a bit and on August 27 we descended to Burzil Chowki on the Gilgit Road. We put in four days here and with Col. Meinertzhagen on his feet again, commenced the final stages to the Vale of Kashmir.

It was a late autumn evening when we crossed the Razdhanangan Pass and looked down on a sea of gardens and fields, and, sparkling through the gathering mists, the gem-like lakes that make the Vale of Kashmir 'a paradise on earth.'

(*The end*)

THE LANGURS, OR LEAF MONKEYS, OF BRITISH INDIA

BY

R. I. POCOCK, F. R. S.

Part II

(With two plates and three text-figures.)

(Continued from page 504 of Vol. XXXII)

II. The PYRRHUS-group.[1]

Distinguishable from the Entellus-group by the uniform golden-red hue which in the newly-born young pervades the whole of the body, limbs and tail above and below. In cranial characters the species more resemble *Pithecus senex* than *Pithecus entellus*.

Distribution. From Assam and Upper Burma southwards through Laos, Siam and the Malay Peninsula to Sumatra, Java and Borneo.

The actual number of species is doubtful; but within the area of British India I admit only two, which may be briefly contrasted as follows:—

(*a*)	A little larger; hair on the crown directed backwards from the brow and forming a thick mat overhanging the occiput and marked off from the short hair clothing the cheeks; face entirely black ...	*pileatus*.
(*a*[1])	Smaller; hair on crown variable but never forming a mat as described above; eye-lids and usually the lips flesh-tinted (in British Indian forms) ...	*pyrrhus*.

Pithecus pileatus, Blyth.

Semnopithecus pileatus, Blyth., *Journ. As. Soc.* Bengal, xii, p. 174, 1843, and xiii, p. 467, 1844.

Semnopithecus, *Presbytis*, *Pygathrix* or *Pithecus pileatus* of Anderson, Blanford, Forbes, Elliot and other authors.

A tolerably large langur characterized by the presence on the crown of the head of a thick continuous mat of backwardly directed or nearly erect hairs extending from the brow in front to the occiput behind and across the head between the temples and ears. Laterally this mat is defined by the shorter hair clothing the temple behind the eye and by the more or less, often greatly, elongated hairs of the cheek, and behind it overlaps the shorter hairs of the fore part of the nape.

The colour is variable but the prevailing tint of the upper side is grey, sometimes suffused more or less with black, especially on the crown; the lower side is whitish, buff or suffused with orange red, rarely grey like the upper side. The face is entirely black as in the Entellus-group, neither the eyelids nor the lips showing any trace of the flesh colour seen in all the British Indian representatives of the following species, *P. pyrrhus*.

Distribution. Assam, north and south of the Brahmaputra and Upper Chindwin to Tipperah, and Chittagong.

The evidence that this species belongs to the group with golden red newly born young was supplied by the birth of young of that colour from a pair kept for many years in the Zoological Society's Gardens, London.

Elliot classified *P. pileatus* with *P. entellus*, stating the two to be allied. They are certainly not closely allied. As living animals they have a very different facial expression. *P. entellus* has a narrow compressed nose, whereas

[1] In the first part of this paper (*Journ. Bomb. Nat. Hist. Soc.* XXXII, p. 474), this group was called the Auratus-group. But since the identity of *Pithecus auratus* in a matter of dispute, I think it advisable to change the name to the Pyrrhus-group.

in *P. pileatus* the nose is flat from side to side. The difference may be aptly compared to the difference between a European and a Negro.

This is borne out by the shape of the facial portion of the skulls. In *P. pileatus* the brow ridge is not prominent, the plane of the orbit is inclined upwards and backwards and the nasal bones are wide. In those respects the skull much more closely resembles the skull of *P. senex* than the skull of *P. entellus*.

In his paper, quoted below, on the langurs of this group, Hinton suggested that the different forms, some of which were regarded as distinct species, would very likely prove to be merely subspecies of a single species. Believing this view to be quite correct, I have adopted it in this paper.

KEY TO THE SUBSPECIES OF *P. pileatus*

(*a*) Whiskers shorter, grey, not noticeably lighter in tint than the crown ... ... *shortridgei*.

(*a*^{1}) Whiskers longer, whitish or reddish and rather sharply contrasted with the darker tint of the crown.

(*b*) No sharp contrast in colour between the upper and lower sides of the body and the outer and inner surfaces of the limbs; throat and breast whiter than the belly ... ... *brahma*.

(*b*^{1}) A sharp contrast between the areas mentioned above; throat and breast not paler than the belly. ... ...

(*c*) Lower side greyish white, tinged with buff on whiskers, throat and breast ... *pileatus*.

(*c*^{1}) At least the whiskers, throat and breast bright rusty red.

(*d*) General colour paler above, head and nape nearly uniform slaty grey, red suffusing underside at least to the groins ... ... *durga*

(*d*^{1}) General colour darker above, head blackish with grey patch on nape; red of the under side fading away on the abdomen. ... *tenebricus*.

Subspecies *pileatus*, Blyth.

Semnopithecus pileatus, Blyth, *Journ. As. Soc.*, Bengal, xii, p. 174, 1843.
Pithecus pileatus pileatus, Hinton, *Journ. Bomb. Nat. Hist. Soc*, xxix, No. 1, pp. 79–80, 1923.
Semnopithecus argentatus Horsfield, *Cat. Mamm. East Ind. Co.*, p. 7, 1851.

Distinguished by the pale colour of the whiskers, throat, underside of the body and inner side of the limbs which are sharply contrasted with the grey hue of the upper parts but are white or whitish and at most faintly tinged with buff or pale red.

Distribution. Assam from the Naga to the Garo Hills.

It is needless to repeat the history of this local race of *Pithecus pileatus* which was fully told by Hinton in 1923 when, on the evidence supplied by Blyth's original description based upon a langur of which the locality was unknown, he restricted the subspecific title *pileatus* to the Capped Langurs with pale under parts.

The colour, however, varies in different individuals assigned to this race. For example, a half-grown female shot by H. W. Wells at Mokokchung in the Naga Hills (5,000 feet) is pale slaty or smoky grey above and on the outside of the limbs and on the tail, with the head and hands a little darker. The whiskers, the whole of the lower side and the inside of the limbs are white and the white extends some distance up the flanks behind the arm-pit. On the hand the white of the inner side passes above the thumb and the fingers are patched with white. The feet are not darker above than the outside of the leg, and the inner edge of the foot and the toes are white. This specimen appears to be

whiter below than Blyth's type of *pileatus*, the under side of which he described as ' dull fulvous white'. This was also an immature female.

An adult male from Mokokchung differs from the female in having the areas which in the female are white, tinged with buff or very pale red ; the hands and feet are darker and there is no white on the fingers or toes, but the extension of the white of the inner side of the leg along the margin of the foot above the great toe is retained.

An adult male from Tura in the Garo Hills, 1,400 feet (H. W. Wells) generally resembles the last-described but is paler on the legs and arms, the outside of the legs below the knees and the top of the feet being much greyer.

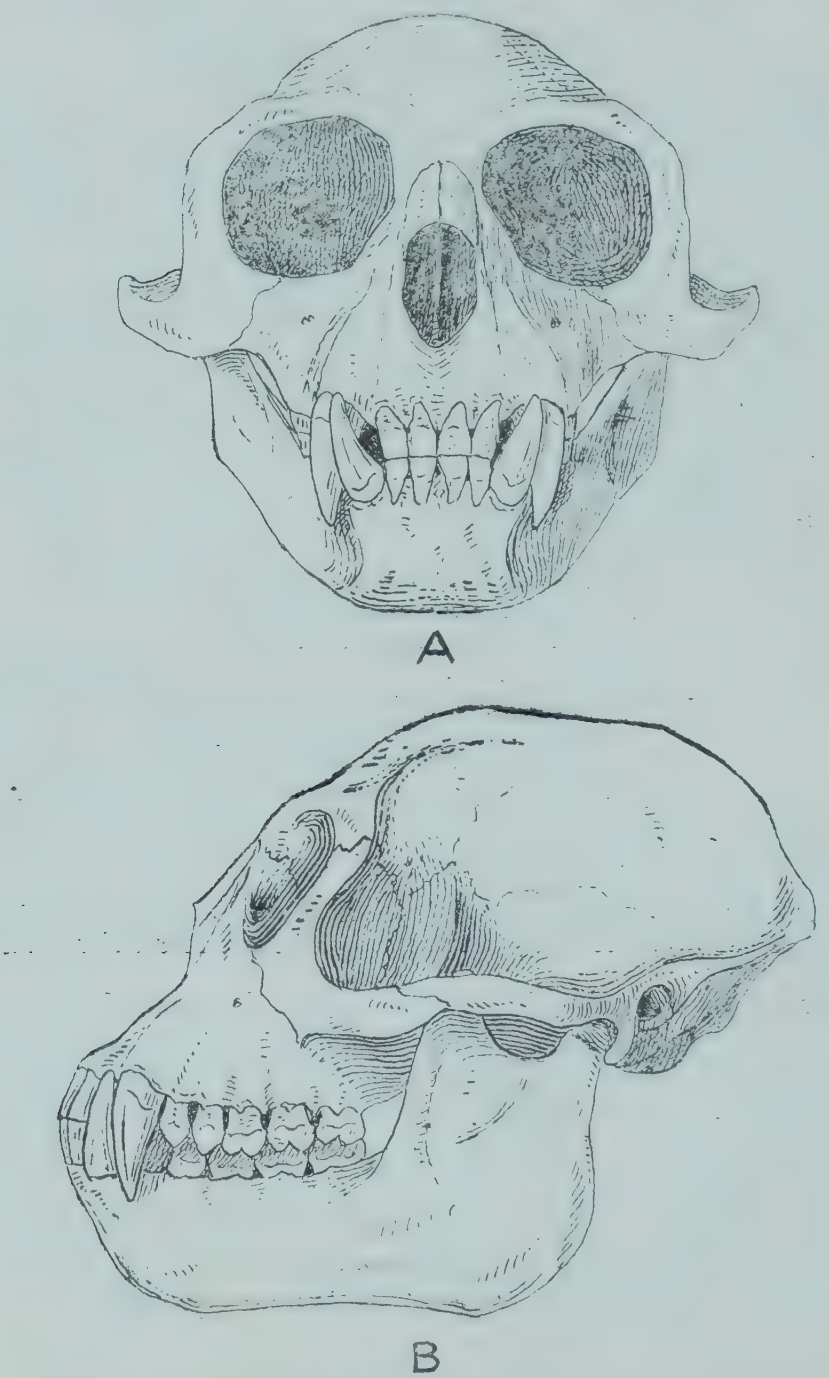


FIG. 1—A and B. Front and side views of skull of adult male *Pithecus pileatus pileatus* from Tura in the Garo Hills.

An immature male from Lait Kynsao in the Kasi Hills, 2,000 feet (H. W. Wells) is very like the adult male from Tura ; and an immature male from Kynshong in the Jaintia Hills, 3,000 feet, has the outer side of the legs below the



The Capped Langur and Young
(*Pithecus pileatus*)

knee greyer than in the older specimen from Lait Kynsao, and, as Hinton pointed out, the terminal portion of the tail is buff instead of blackish.

The redder hue of the under side of these young males from the Khasi and Jaintia Hills distinguishes them markedly from the immature but older female from the Naga Hills. They serve to connect the typical form of *pileatus* with the intensely red-bellied form recorded below as *Pithecus pileatus durga*. So also in a measure does the type of *argentatus* so far as can be judged from a specimen in a very poor state of preservation. This langur, an immature specimen, came from Sylhet, and the hair that remains on its under side suggests that, when freshly killed, the monkey was redder on the chest than are the adult males from the Garo and Naga Hills described above. It is also browner on the dorsal area. Since, nevertheless, the skin is not nearly so red beneath as in the typical red-bellied Capped Langur described below, I follow Wroughton in assigning *argentatus* to the synonymy of *pileatus* proper, at all events until fresh material of this langur from Sylhet shows that opinion to be wrong. It may be proved that the type of *argentatus* is an immature specimen of the red-bellied form which has lost its redness by fading.

The photograph of the Capped Langur *Pithecus pileatus* reproduced on Pl. III of this paper was taken from a specimen from Assam living in the Zoological Gardens, London.

Subspecies *durga*, Wroughton.

Presbytis pileatus, Blyth, *Journ. As. Soc.*, Bengal, xvi, p. 735, pl. xxvi, fig. 3, 1847.

Presbytis durga, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiv, No. 4, p. 655, 1916.

Pithecus durga, Hinton, *Journ. Bomb. Nat. Hist. Soc.*, xxix, No. 1, p. 79, 1923.

Pithecus pileatus saturatus, Hinton, *tom. cit.*, p. 81.

Distinguished from *P. p. pileatus* by the intensity of the redness of the areas which in the typical form are at most faintly tinged with that colour.

Distribution. Assam, north of the Brahmaputra from Lakhimpur to the Naga Hills and Cachar; thence southwards into Tipperah and Chittagong.

From the evidence supplied by collectors it appears that this erythristic form occurs at lower levels than the typical form with the paler under side. For example, in the Naga Hills typical *pileatus* was taken at Mokokchung at an altitude of 5,000 feet and *durga* at Lakhuni at 2,000 feet.

In his tabular classification of the langurs of the *pileatus* group, Hinton, following Wroughton, described the colour of the whiskers and under surface of *P. durga* as 'ochraceous'. They are, on the contrary, markedly red, as red to all intents and purposes as in the form he named *P. pileatus saturatus*. The general colour of the upper side of both forms he described as dusky brown. As a matter of fact the type of *durga* is somewhat browner and dirtier looking than the comparatively recently killed langurs referred to *saturatus*; but it must be remembered it is a specimen that belonged to Dr. Reid and has been many years in the British Museum and the difference may I think, be assigned to that cause or to discoloration due to the original method of preservations, such as that which gave rise to the difference between the skins of typical *Pithecus pileatus shortridgei* and those that Wroughton distinguished a *P. shortridgei belliger*. Also, I think, that soiling, or the make up, of the skin of *durga* explains the apparent difference Hinton noticed between it and *saturatus* in the width of the dusky brown dorsal area and the less sharp contrast when the skin is viewed from above, between it and the red hue of the flanks. The teeth of the type of *durga* are, it is true, a little larger than in *saturatus*; but I feel tolerably sure that this will break down as a difference when more specimens come to hand.

Now the label on the type of *durga* bears the locality Upper Assam, Cachar. No doubt, however, as Wroughton decided, 'Upper' was a mistake for 'Lower'. Taking, then the locality as probably Cachar, it is significant in view of the claimed identity between *durga* and *saturatus* that examples assigned to *saturatus* by Hinton were collected by the Mammal Survey at Lanka and Lamsahkang in North Cachar. It does not seem probable that two subspecies of *P. pileatus*, both intensely red below, occur in that district of Assam.

Although I have not seen examples of this form from Tipperah and Chittagong, I have added those countries to its distributional area because Blyth's description and coloured figure of specimens therein collected agree in all essentials, as Hinton also thought, with those to which he gave the name *saturatus*.

Blyth regarded these red langurs as identical with his typical *pileatus* of which he had previously seen a single specimen which was whitish below and came from an unknown locality; and from the material in his hands he inferred that the redness of the under side was characteristic of the male. In this he was mistaken because in a pair collected by H. W. Wells at Golaghat at 400 feet the male is not redder than the female.

This pair is also interesting in other ways. The male, although not redder than the female, is darker grey above and on the outside of the limbs and blacker on the hands, feet and tail, the feet being quite black, whereas in the female they are grey. Moreover, the female, apart from being brighter red, especially upon the sides of the neck and upper part of the flanks, is very like the adult male from Tura in the Garo Hills, 1,400 feet, which has been referred above to the typical form *pileatus pileatus*. Nevertheless, it is not so deep a red as an adult male from Lanka, 400 feet, in North Cachar. It may indeed, be described as intermediate between the male *pileatus* from Tura and the male *durga* (*saturatus*) from Lanka.

Individual variation in redness is attested by other specimens. For instance a female from Lamsahkang, 800 feet, in the Cachar Hills, has the red more diffused than in the male from the same spot. It invades the outer side of the leg replacing the normal grey of the limb which is retained in the male.

Subspecies *tenebricus*, Hinton.

Pithecus pileatus tenebricus, Hinton, *Journ. Bomb. Nat. Hist. Soc.*, xxix, No. 1, p. 81, 1923.

Distinguishable from the two preceding local races by the darker tint of the upper surface. The head, back, outer surface of the arm and hand, and the base of the tail are ashy black; the leg is somewhat greyer and there is a half-collar of grey tipped hairs defining the cap on the back of the head. The base of the whiskers, the throat, chest and shoulders are almost as deep a red as in *P. pileatus durga*, but the whiskers are especially grey as in *P. pileatus brahma* and it is noticeable that the redness of the under side is much less pronounced on the abdomen and inguinal region, which in the male are whitish and in the female pale red.

A young specimen is darkisn grey above and on the outside of the limbs, but is whitish below with a yellow tinge on the cheeks and chest. It is darker above than a young male of *P. pileatus pileatus* of about the same age from Konshnong in the Jaintia Hills.

Distribution. Assam, north of the Brahmaputra; North Kamrup on the Matunga River, 1,200 feet and Bogra Nadi, 2,000–3,000 feet.

Subspecies *brahma*, Wroughton.

Presbytis brahma, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiv, No. 4, p. 654, 1916 and xxv, No. 4, p. 559, 1918.
Pithecus brahma, Hinton, *Journ. Bomb. Nat. Hist. Soc.*, xxix, No. 1, p. 79, 1923.

Tolerably uniformly slate-grey on the summit of the head, the back and the outside of the limbs and on the tail, but the limbs and tail darkening towards their extremities. The inside of the limbs paler grey but not sharply distinguished from the tint of the outer surface, with no pale line, involving the hallux on the inner side of the foot. Whiskers white and sharply contrasted close to the face as in the typical form of the species, but ashy at the tips as in *tenebricus*. The throat and chest whitish; abdomen the same but tinged with reddish buff especially on the flanks.

Distribution. Seajuli in the Dafla Hills, Lakhimpur, Assam, north of the Brahmaputra.

A single example only of this fine langur is known. Although regarded by Wroughton and Hinton as representing a distinct species, its characters are, in my opinion, of subspecific value; and I do not doubt that intermediates between it and the other races will be discovered.

The peculiarities in colour to be noted are the absence of sharp contrast in tint between the outer and inner surfaces of the limbs such as is seen in *pileatus*, *durga* and *tenebricus*, and the slight suffusion of the flanks and abdomen with pale red, the throat, whiskers and chest being white. In the other races which exhibit more or less pronounced erythrism, that tint is, at all events as a rule, more pronounced upon the whiskers, throat and chest than on the abdomen.

Subspecies *shortridgei*, Wroughton.

Presbytis shortridgei, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiv, No. 1, p. 56, 1915.
P. shortridgei belliger, *id. loc. cit.*, p. 57.
Pithecus shortridgei, Hinton, *Journ. Bomb. Nat. Hist. Soc.*, xxix, No. 1, p. 79, 1923.

General colour very much as in *brahma*, uniformly slate-grey all over the dorsal surface and on the head, but the ventral surface grey and the whiskers wholly grey and not appreciably differentiated in tint from the crown. No trace of erythrism anywhere in the pelage.

Skull as in the other races of *P. pileatus*.

Distribution. Upper Chindwin: Homalin (400 feet), Minrin (450 feet) and Hkamti (500 feet).

This fine langur is at once distinguishable from the other known forms of the species by the greyness of the whiskers which gives it a very different appearance. Apart from that, however, and the absence of the rufescence of the ventral surface, the colour is very like that of *P. pileatus brahma*. But in the latter, as in *P. pileatus tenebricus*, the tips of the whisker hairs are grey. Although no intermediates between *brahma* and *shortridgei* are known, there is no doubt, in my opinion, that they will be found, because the colour-differences between them are comparatively slight. Hence I regard *shortridgei* merely as a local race of *P. pileatus*.

The examples from Hkamti to which Wroughton gave the name *belliger* are browner in hue than the others; but this difference, as he afterwards learnt from the collector, G. C. Shortridge, is due to discoloration from smoke in the preparation of the skins.

Since the subspecies of *Pithecus pileatus*, above discussed, are to all intents and purposes alike in size, the approximate dimensions in inches of a few representative examples may be conveniently set forth in one table :—

Locality and Sex	Head and body	Tail	Hind foot	Ear	Weight
pileatus—					
Garo Hills, ♂ ...	28	41	7½	1⅓	...
Jaintia Hills, ♀ ...	23	35	7½	1⅓	21½ lbs.
durga—					
Lakhimpur, ♂ ...	27½	39	7¾	1⅓	...
N. Cachar, ♂ ...	23	41	9 (?)	1½	27 lbs.
,, ,, ♀ ...	20	...	...	...	...
tenebricus—					
N. Kamrup, ♂ ...	22½	36½	7	1½	19½ lbs.
,, ♂ ...	20	36	7	1½	..
,, ♀ ...	22½	34	7	1½	...
,, ♀ ...	18	28½	6½	1½	...
shortridgei—					
Upper Chindwin, ♂ ...	28½	41	8 —	1½	30 lbs.
,, ,, ♂ ...	27	40	8 —	1½	...
,, ,, ♀ ...	26	38	7½	1⅓	21½ lbs.

The dimensions of the skulls in milimetres are as follows :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital width	Zygomatic width	
pileatus—						
Naga Hills, ♂ ...	118	35	29	75	...	
Garo Hills, ♂ ...	115	35	28	70	89	
Garo Hills, ♀ ...	102	30	28	65	75	
durga—						
N. Cachar, ♂ ...	119	37	28	74	86	
Cachar (?), ♂ ...	117	36	30	74	86	type of *durga*.
Lakhimpur, ♂ ...	116	35	26	76	87	type of *saturatus*.
Naga Hills, ♀ ...	111	35	30	68	79	
tenebricus—						
N. Kamrup, ♂ ...	113	32	28	66	80	type; not full grown.
,, , ♀ ..	98	29	28	63	77	
brahma—						
Lakhimpur, ♂ ..	110	34	27	70	...	
shortridgei—						
Chindwin, ♂ ...		38	30	79	91	type of *shortridg*.
,, ♂ ...	115	37	28	73	85	
,, ♂ ...	114	36	29	75	92	type of *belliger*.
,, ♀ ...	104	32	28	71	77	

The body-measurements taken from freshly killed animals show that the males are larger than the females and that there is no great difference in size between the adults of all the races. An apparent exception to this is supplied by *tenebricus* in which an adult female is as large as the larger of the two males; but examination of the skull of this male, the type, shows that the basioccipital suture is still open, indicating that growth had not ceased.

Of *brahma* unfortunately no measurements in the flesh were taken. The skull which is that of an adult is decidedly small.

With regard to the tooth-measurements it will be noted that there is considerable difference between the types of *durga* and *saturatus* in that respect. But the teeth in the type of *saturatus* are old and worn and have probably lost a little in total length. Another male belonging to Mr. Hinton's series of *saturatus* is intermediate between the two and a female of the same set from Lakuni in the Naga Hills has the tooth-row as long as in the type of *durga* although the teeth are a little narrower.

Note.—The langur now known as *Pithecus potenziani*, Bonaparte (= *chrysogaster*, Lichtenstein), which was quoted as a synonym of *pileatus* by Anderson and was sceptically included by Blanford as a member of the fauna of British India on the erroneous record of the occurrence of the species in Tenasserim, is in reality an inhabitant of the Mentawei Islands off the west coast of Sumatra.

It is a very interesting species related, in my opinion, to *pileatus*. Its prevailing colour is jet black above, with a considerable amount of rusty red hairs on the ventral surface. The th oat and cheeks are white, as in *pileatus*, and a white band extends from the temples over the brow, as in immature examples of *P. pileatus*, and, as in that species, the whiteness of the whiskers spreads over the base of the ear. The newly-born young too is golden.

One would be almost inclined to regard this langur as a small, insular melanistic race of *pileatus* were it not that the whiskers are shorter and more

bushy and the crown of the head has no mat-like cap, but a compressed crest or tuft as in some forms of *Pithecus pyrrhus*. The species serves in a measure to link *P. pileatus* and *P. pyrrhus*.

Pithecus pyrrhus, Horsf.

Semnopithecus pyrrhus, Horsfield, *Zool. Res.*, Java, 1820, and of many subsequent authors, including Thomas and Wroughton, *Proc. Zool. Soc.* London, 1909, p. 372. (*Presbytis*).

Semnopithecus or *Presbytis maurus*, E. Geoffroy, 1812, and of many subsequent authors; but not *Simia maura* of Schreber.

Resembling *P. pileatus* in the uniform golden or golden red colour of the newly-born young but differing in being smaller and in the mode of growth of the hair on the crown which never forms a mat or cap as described under that species. Its arrangement is very variable. Occasionally there is a whorl on the forehead and not infrequently there is an erect tuft or crest on the summit of the head to which a good deal of importance has been attached, although in certain cases there seems no doubt that its occurrence is individually variable. Sometimes, again, the hair lies smoothly back from the brow to the nape of the neck, at others it is upstanding and roughly arranged like a mane. The whiskers are typically long and blend with the hairs of the crown. The colour varies from subspecies to subspecies, but is in some cases subject to individual variation to a pronounced degree, but the inside of the thighs never shows the whiteness so characteristic of the species of the following group, which *Pyrrhus* overlaps in range.

Distribution. From Upper Burma southwards and eastwards into Annam, Siam, the Malay Peninsula, the Sunda Islands and Borneo.

For the typical Javan form of this species Elliot (*Rev. Primates*, iii, p. 75, 1913) adopted the name *auratus* Geoffroy (1812), which has priority over *pyrrhus*. But his statement that the type of *auratus*, which he saw in Paris, is indistinguishable from examples of *pyrrhus* in the British Museum, is shown by the description of *auratus* to be untrue. And since, in my opinion, all the available evidence suggests that *auratus* belongs to the *Aygula*-group of Langurs, I do not propose to discuss it further here.

In Java *P. pyrrhus* is commonly either red or jet black, being addicted to erythrism or melanism. But a third variety is blackish, grizzled to a varying extent with buff or grey; and this variety passes into the Sumatran form known as *cristatus* or *pruinosus* which also occurs in the Malay Peninsula and is in my opinion only subspecifically distinguishable from a form from Siam and Cochin China named by M. Edwardes *germaui* but usually quoted as *germaini*; and through a form from Annam, named *margharita* by Elliot, *germani* passes into the typically Siamese Langur assigned in this paper to *crepusculus* which is closely akin to the Burmese *phayrei*. On the other hand, in the Malay Peninsula *cristatus* passes into the Tenasserim form described below as *atrior* which is very similar to another Burmese form, *barbei*, and to the Malayan form *obscurus* and has been identified under both those names.

This brief epitome of the evidence of intergradation between the Javan Langur *pyrrhus* and others occurring in more northern countries of tropical Asia is the explanation of my adoption of the name *pyrrhus* as the specific title for all those forms.

A few words may be said about the Langur known as *obscurus*, because that name figures largely in the literature relating to the Langurs of British Burma. As stated below, it was applied by Blyth, Thomas and Blanford to Langurs as widely separated geographically as Bhamo and Tenasserim and this is eloquent testimony of the closeness of the affinity between these monkeys. Now the name *Semnopithecus obscurus* was given by Reid in 1837 (*Proc. Zool. Soc.*, p. 14) to a menagerie specimen of which the locality was unknown. Fortunately Martin in 1838 saw the specimen and identifiably described it (*Mag. Nat. Hist.*, ii, p. 440). The hair on the back of the head formed a crest and was ashy in tint, thus contrasting with the blackish-brown or brownish-black hue of the rest of the head and body. The middle line of the back was apparently browner, the outside of the thighs greyish brown, the hands and feet black and the tail dark ashy grey.

This description applies tolerably closely to many examples in the British Museum from various places in the Malay Peninsula, but the crest on the head is not usually present. This race of *Pithecus pyrrhus* does not apparently enter the British Indian area; but two closely related subspecies occur in its southern portion.

A photograph of the Dusky Langur *Pithecus pyrrhus obscurus* that was living in the Zoological Gardens, London is reproduced on Pl. IV of this paper.

KEY TO THE BRITISH INDIAN RACES OF *P. pyrrhus*

(*a*) A whorl or parting on the forehead behind the brow ... ... *shanicus*.
(*a*^{1}) No definite hair-whorl on forehead.
(*b*) No distinct cap of pale hair on the back of the head and nape.
(*c*) General colour lighter or darker, but lustrous grey, buff or brown in reflected light; lips flesh-coloured.
(*d*) Grey, buff or greyish brown above, grey to white below; base of tail grey.
(*e*) White or nearly white below; typically a tuft on the head ... ... *phayrei*.
(*e*^{1}) Grey below; tuft on the head present or absent ... ... *crepusculus*.
(*d*^{1}) Colour darker, brown above, deeper grey below; base of tail brown; no tuft ... *barbei*.
(*c*^{1}) General colour deep brown to nearly black sometimes varied with grey specking; hair less lustrous; lips black ... ... *atrior*.
(*b*^{1}) A sharply contrasted pale grey or buff cap on the back of the head and nape.
(*f*) Body and arms blacker, legs not sharply contrasted with loins ... ... *sanctorum*.
(*f*^{1}) Body and arms browner, legs grey and sharply contrasted with loins ... *flavicauda*.

Subspecies *barbei*, Blyth.

Presbytis barbei, Blyth, *Journ. As. Soc.*, Bengal, xvi, p. 734, 18; *id. Cat. Mamm. Mus. As. Soc.*, p. 14, 1863; *id. Mamm.* Birds, Burma, p. 11, 1875.
Semnopithecus barbei, Anders., *Ann. Zool. Res.*, Yunnan, p. 12, 1878 and *Cat. Mamm. Ind. Mus.*, pt. i, pp. 48-49, 1881 (in part); Blanford, *Mamm. Brit. India*, p. 39, 1891.
Presbytis melamera, Elliot, *Ann. Mag. Nat. Hist.* (8), iv, p 267, 1909, and *Rev. Primates*, p. 47, 1912.

With no whorl or parting in the hairs of the forehead and no crest on the crown of the head. Lips and eyelids flesh coloured and contrasting with the blackish hue of the rest of the face. General colour dark brown above with a pale buff sheen especially noticeable on the head and shoulders. The hind limbs and tail only slightly paler than the back. The under side dark grey. Hands, feet and brow black.

Distribution. Interior of the Tipperah Hills and from the Kakhyen Hills as far south as Bhamo.

There has been considerable doubt about the identity and geographical distribution of this langur. In his original description Blyth stated that the skins came from the Ye Province of Tenasserim; but later, from information received from the collector, he corrected this to the interior of the Tipperah Hills. This alteration was accepted by Anderson and Blanford, although in his description of the monkey Anderson cited Tenasserim as one of its areas. He probably had in his hands specimens of the dark race from Northern Tenasserim, described below, which is very like *barbei*. However that may be, it appears to me that Blyth's correction of the locality must be accepted, especially as the Rev. J. Barbe, after whom this langur was named, is known to have collected in Chittagong and the Tipperah Hills because he secured there examples of *Pithecus pileatus*, a species which certainly is not found in Tenas-



THE DUSKY LANGUR
(*Pithecus obscurus*)

serim. I cannot, therefore, agree with Wroughton's decision to take Tenasserim as the locality of *barbei*.

The acceptance of the interior of the Tipperah Hills as the locality of the type of *barbei* renders probable, on geographical grounds, the correctness of Anderson's identification as *barbei* of specimens which he collected in the Kakhyen Hills and on the Irawaddy above Mandalay. Until evidence to the contrary is forthcoming, I shall assume he meant the state of Mandalay which is just to the north of Bhamo. Now at a place called Cadu Ciaung, Bhamo, L. Fea long ago secured a species of langur, and one of his specimens, presented to the British Museum and identified by Thomas as *obscurus*, was subsequently described by Elliot as representing a new species to which he gave the name *melamerus*; and this specimen agrees sufficiently closely with Anderson's description of the specimens he identified as *barbei* as to leave little doubt that it is the same kind of langur. Acting, therefore, on the assumption that Anderson's Kakhyen examples were correctly named *barbei*, I have added *melamerus* to the synonymy of *barbei* and have taken my diagnosis of *barbei* from the type of *melamerus*, the only available specimen.

This specimen agrees with Blyth's original, but brief, description of *barbei* in the absence of the crest, in having the face and the under side coloured as in *obscurus*, in the whiteness of the 'interior base of the thigh', and in the tail being only slightly paler than the body; the shoulders and outside of the arms cannot be described as silvered, but other subspecies of *P. obscurus* vary in the grey or buff sheen of the upper side.

Anderson, who had access to the typical example of *barbei* in Calcutta and presumably identified the langurs he procured in the Kakhyen Hills by comparison with it, described the colour as blackish brown above with the sides and back of the head, the shoulders, fore-limbs, the lower parts of the hind limbs and the tail as greyish brown, the hands, feet, eyebrows and whiskers being black and the under parts nearly the same. But from his citation of Mount Mooleyit in Tenasserim as a locality for *barbei*, it may be presumed that his description applied also to examples from that area which, as stated below, appear to me to represent a distinct local race.

Blanford, to whom this langur was unknown, added to the difficulty of identifying it by placing it in his synopsis in a totally different section from *phayrei*.

Subspecies *phayrei*, Blyth.

Presbytis obscurus, Blyth., *Journ. As. Soc.*, Bengal, xiii, p. 466, 1844 (not typical *obscurus* of Reid).

Presbytis phayrei, Blyth., *Journ. As. Soc.*, Bengal, xvi, p. 733, pl. xxxvii, fig. 3, 1847; also of Anderson and Blanford (in part).

Presbytis phayrei, Wroughton, *Journ. Bomb. Nat. Hist. Soc.*, xxiii, No. 3, p. 464, 1915 and *op. cit.*, xxiv, p. 297, 1916.

Semnopithecus holotephreus, Anders., *Zool. Res.*, Yunnan, p. 27, 1877.

A crest or tuft on the crown of the head but no parting on the forehead; lips flesh coloured and eyes partly or wholly encircled by the same tint. The general colour is variable, being lighter or darker brown above with a varying extent of greyish sheen over the back and the outside of the limbs, the tail is dark like the back but sometimes paler at the base or throughout. The under side is distinctly white or whitish and contrasted strongly or moderately with the colour of the flanks.

Although closely related to *barbei*, this race may be distinguished from it by the whiteness of the under side and by the presence of the erect crest on the crown of the head.

Distribution. Arakan; the Bassein district of Pegu; Prome; Mount Popa.

Under the name *Presbytis, obscurus*, Blyth gave a very good description of this langur, having skins of adults and young collected in Arakan by Capt. Phayre; and Blanford shot specimens in the Bassein district of Pegu west of the Bassein river; but the specimens from Moulmein he referred to *phayrei* belong, I think, to another local race, *crepusculus*.

In the British Museum there is a half grown specimen from Arakan which was received long ago from the Asiatic Society of Bengal and was for many years exhibited in the public gallery. It may be regarded as topotypical, since Blyth gave no definite spot in that district for his type specimen. It is

dull, lustreless and dark brown above and white below, the white contrasting with the dark hue of the flanks; thus it agrees closely with Blyth's coloured figure of the type of *phayrei*. An adult from the S. Zmayi Reserve, 500 feet (J. M. D Mackenzie) is also like Blyth's type in those respects, being dark brown above with the white of the ventral surface strongly pronounced and sharply contrasted. It has also a considerable amount of white on the inner side and back of the thighs. Also an immature individual from a spot 30 miles S.E. of Prome, 300 feet (J. M. D. Mackenzie) presents the same style of coloration as the example from Arakan ; but an adult from the same locality is not so white below and is greyer above. Individual variation between specimens from the same place is also shown by two from Yin on the Lower Chindwin collected by Mr. Macmillan. One is dark brown above and on the outside of the thighs, but is not so white below as in the specimens mentioned above; the other is greyer on the back and legs. This specimen and the greyer of two examples taken 30 miles S.E. of Prome link the typical darker forms with a good series collected by G. C. Shortridge at 4,961 and 4,981 feet on Mount Popa, and the one from Yin on the Lower Chindwin (G. W. Dawson) mentioned above. These are brown with a distinct grey sheen all over the upper side, the amount of the grey sheen varying individually; the under side is white or whitish but not very strongly contrasted with the flanks.

These Mount Popa langurs, as originally pointed out by Wroughton and Shortridge, differ from the langurs from the Shan States to the north for which I retain Wroughton's name *shanicus*, in having no whorl of radiating hairs on the forehead and in exhibiting the upstanding crest on the crown. They are also somewhat paler above and whiter below. They also differ from *barbei*, as here understood, in being greyer above, whiter below, and in possessing the crest. They come nearest to the form described below as *crepusculus*, differing from it apparently only in having the under side whitish instead of ashy grey.

I have added *holotephreus* to the synonymy of *phayrei* to eliminate it from the list of so-called species of *Pithecus*. The following considerations justify, in my opinion, this course. (1) The description mentions no character by which it can be definitely separated from *phayrei*. (2) The locality of the specimen was unknown. (3) According to Elliot the type was not found in the Calcutta Museum where it was supposed to be preserved. Elliot suggested that it might be a synonym of *barbei*; but the 'pale yellowish grey' tint of the under side agrees better with *phayrei*. The type, moreover, had a crest on the crown of the head which is present in *phayrei* but was not recorded in the case of *barbei*.

Subspecies *shanicus*, Wroughton.

Presbytis barbei, Wroughton, *Journ., Bomb. Nat. Hist. Soc.*, xxiii, p. 465, 1915.
Presbytis shanicus, Wroughton, *Journ., Bomb. Nat. Hist. Soc.*, xxv, p. 47, 1917.
Pithecus melamerus, Wroughton, *Journ., Bomb. Nat. Hist. Soc.*, xxvii, p. 552, 1921. (Not *melamerus*, Elliot).

A dark brownish form closely resembling *barbei*, as represented by the type of *melamerus*, in colour, but distinguished from it and from all the other British Indian races of *Pithecus pyrrhus* by possessing on the forehead a naked spot whence the hair radiates in all directions as in the *entellus* langurs.

Distribution. North Shan States in Upper Burma.

The example of this race which first came to hand and was identified as *barbei* by Wroughton was collected by G. C. Shortridge at Ngapyinin opposite Kyonk Myoung to the east of the Irawaddy. Shortridge noticed that it differed from langurs he collected on Mount Popa, which were identified as *phayrei*, in possessing the frontal whorl, in having no upstanding crest on the crown, and less pallid skin round the eye, the area being reduced to half circles on the inner side of those organs. Nevertheless, in his description of *phayrei*, Blyth stated very definitely that the eyes were surrounded on the inner side by flesh-coloured skin.

When Shortridge subsequently secured similar specimens in the North Shan States, at Séen, Gokteik (2,133 feet) and Pyaung yaung, Wroughton decided to give a new name to the series because he ascertained from the late Dr. Annandale that the type of *barbei* in the Calcutta Museum has no frontal

parting in the hairs. He therefore named them *Presbytis shanicus*, selecting a Séen specimen as the type of the species.

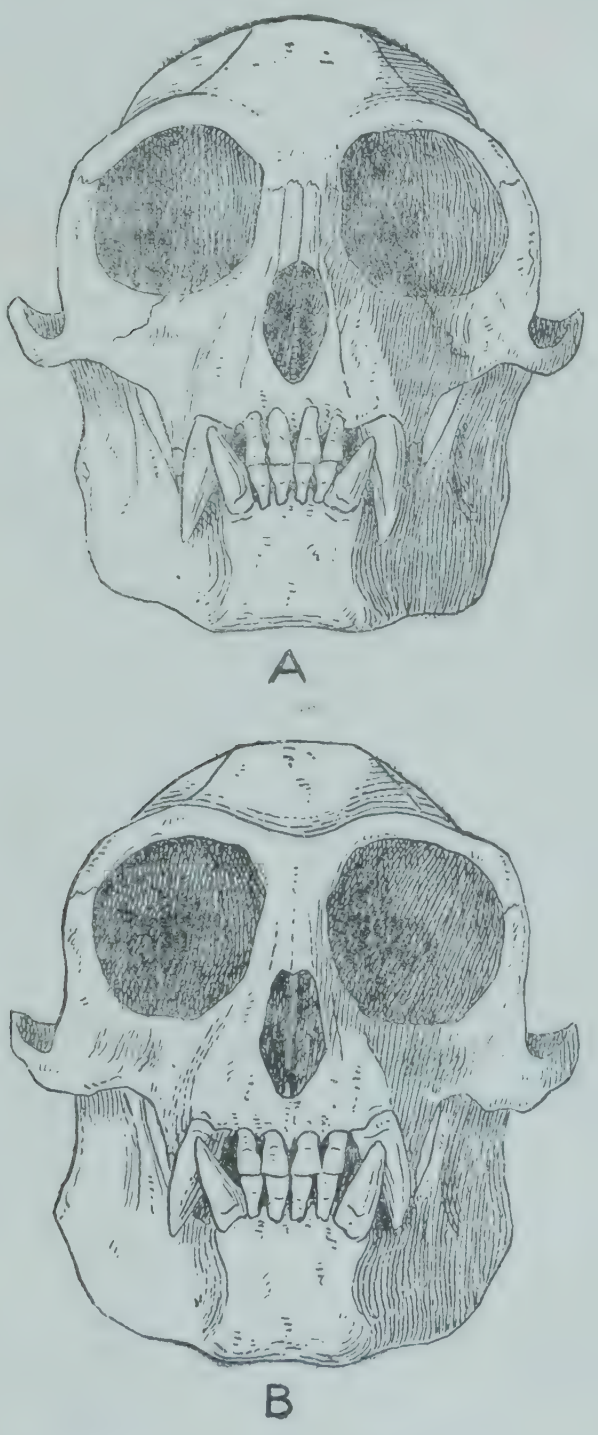


FIG. 2.—Front view of skull of adult male *Pithecus pyrrhus shanicus* from Gokteik in the North Shan States, two-thirds natural size.

B.—The same of *Pithecus pyrrhus atrior* from the Ye Forest, Tennasserim.

Later, however, he came to the conclusion that these North Shan langurs were identical with the form from Cadu Ciaung, Bhamo, which Elliot had described as *Presbytis melamerus*; and in Wroughton's summary *melamerus* appears in the table amongst the *entellus* group which present the frontal whorl. But as I have stated above, the type of *melamerus*, which is in the British Museum, has no parting on the forehead at all comparable to that shown by adults and young from the North Shan States.

It must be admitted that this difference between langurs so alike in colour and so close to one another in geographical distribution is very singular; but on the available evidence, I do not think it would be justifiable to ignore the character. I have, therefore, decided to admit *shanicus* as a subspecies of *Pithecus pyrrhus*.

Subspecies *crepusculus*, Elliot.

Presbytis phayrei, Tickell, *Journ., As. Soc.*, Bengal, xxviii, p. 428, 1859.
Presbytis crepuscula and *crepuscula wroughtoni*, Elliot, *Ann. Mag. Nat. Hist.*, (8), iv, pp. 271–272, 1909; and *Rev. Primates*, ii, pp. 84–85, 1912 (under *Pygathrix*).

Intergrading with *phayrei*, but on the average paler and greyer above and not so white below, the ventral surface being grey and sometimes hardly paler than the dorsal.

Distribution. Northern Tenasserim and adjacent areas of Siam and Laos.

Two examples of this race preserved in the British Museum and collected by Davison at an altitude of 5,000 feet on Mount Mooleyit, to the west of Moulmein, were identified by Blanford as *phayrei* and reasonably considered by him to be the same as the langur from near Moulmein referred to *phayrei* by Tickell.

These specimens were named *Presbytis crepuscula* by Elliot. The two differ in tint being in different stages of pelage, as Elliot pointed out. One is tolerably uniformy brown all over the upper surface, and on the arms, hands and feet some rusty brown hairs are retained, so that the extremities are not black as is typically the case in *P. pyrrhus*. The other, in fresh pelage, is greyer, with black hands and feet, and scarcely differs from Mount Popa examples of *phayrei* except that the belly is greyer and the base of the tail the same tint as the loins. There is also no upstanding crest on the head. Another example collected by A. S. Vernay at an altitude of 1,000 feet at Lampha in Tenasserim is almost identical with the greyer of the two Mount Mooleyit specimens.

This race also spreads into Siam. From this country the British Museum has a large number of specimens, exhibiting considerable range in the tint of the upper side from various localities. A brownish specimen from Pacheburi was named *crepuscula wroughtoni* by Elliot, but I can find no evidence to justify its separation from *crepusculus*. In a series of three examples collected by A. S. Vernay on the Mewong River 40 and 53 miles east of Um Pang at 800 and 1,000 feet, and one 28 miles southeast of Um Pang at 1,750 feet, no two are quite alike, the tints of the back varving in greyness and brownness and sheen and of the arms in darkness according apparently to the age of the pelage. Another obtained by Mr. Vernay at Kempenpet on the Klong Klung River is characterized by a marked buffy sheen over the neck and shoulders. Others obtained by K. G. Gairdner in Seeswad at about 2,000 to 3,000 feet are dull, dirty-looking skins, their tint being due probably either to the method of preservation or to oldness of the pelage.

The only other specimen I need refer to is a beautiful skin wtth long greyish hair obtained by Messrs. J. Delacour and W. Lowe at Xien Quang Koa in Laos. This has recently been identified by Thomas as *Pithecus phayrei*.

It may be added that the tuft on the head usually regarded as characteristic of *phayrei* may be present or absent in these specimens It may be always present and erect in the living animals, but it is not always preserved in dried skins.

Subspecies *flavicauda*, Elliot.

Semnopithecus obscurus, Blanford, *Mamm., Brit. India*, p.4?, 1888 (in part).
Pygathrix flavicauda, Elliot, *Proc. U. S. Nat. Mus.* xxxviii, p. 352, 1910, and *Rev. Primates*, ii, p. 50, 1912.

Closely related to typical *obscurus* and *sanctorum*, with a similar pale grey or greyish buff patch on the back of the head but differing in the very sharp contrast between the grey or greyish buff tint of the tail and of the outer side of the hind legs and the blackish loins. The sides of the back are blackish brown, but the centre is browner and this tint, only somewhat paler, pervades

the shoulders and arms. The head, apart from the back of the crown, is black, as also are the hands and feet, and the under side is greyish brown.

Distribution. Southern Tenasserim, Mergui Archipelago and parts of Peninsular Siam.

The British Museum possesses many examples of this race. One collected by Davison at Bankasun (Bankachon) in S. Tenasserim was ascribed by Blanford to *obscurus*. Others from the same locality were collected by G. C. Shortridge who also got one in Tenasserim Town and another at Banlaw on the Great Tenasserim River. These specimens exhibit variation in the distinctness of the pale areas. There is also an example from King Island, Mergui, collected by Mr. C. Primrose; and Elliot records the race from Sir William James Islands, Mergui. The type of his *flavicauda* came from Trong in Lower Siam.

Subspecies *sanctorum*, Elliot.

Presbytis sanctorum, Elliot, *Proc. U. S. Nat. Mus.*, xxxviii, p. 351, 1910; *Rev. Primates*, p. 55, 1913.

Mostly blackish above with some brown on the middle of the back behind the shoulders and the outside of the limbs at most a little paler than the upper side of the body, the hands and feet being, as usual, black. But the tail is pale buffy grey and the patch on the head whitish. The lower side is uniformly brownish grey.

Distribution. St. Matthew Island in the Mergui Archipelago.

I have not seen an example of this Langur, my description being adapted from the remarks of Elliot who declared that in colour *sanctorum* is very like a race inhabiting Terautau and Langkawi Island in the Straits of Malacca, named by Thomas *Presbytis obscurus carbo*, except that the nuchal crest is creamy white and the tail pale buffy grey. The specimens of *carbo* in the British Museum represent a dark insular race closely akin to the mainland race *obscurus*, and, in view of Elliot's statements, I have been compelled to judge of the colour of *sanctorum* from them

Subspecies *atrior*, nov.

A very dark form nearly uniformly coloured deep, dusky brown all over the upper parts and the outside of the legs, with less sheen on the hairs; but the outer side of the arms, especially about the elbows, is paler than the shoulders and back. The under side is dark, dusky greyish brown. The tail is at most only slightly paler than the body.

Distribution. Northern parts of Tenasserim and adjoining areas of Siam.

Type. Ye Forest, 500 feet, in the island of Moulmein in the Ataran Division of Tenasserim. (G. F. R. B. Thurling. B. M.).

This langur may be the same form as the specimen, or specimens, from Mount Mooleyit referred by Anderson to *Semnopithecus barbei*. In the darkness of its tint it is very like the example from Bhamo described by Elliot as *melamerus*, which I identify with *barbei*; but it is somewhat darker above and below, has little or no white on the back of the thigh, and the skin of the lips and chin is black in all the examples seen and not flesh-coloured as in *barbei*, *phayrei* and other races described above.

In addition to the type above mentioned the British Museum has an example collected by Davison at the foot of Mount Nwalabo, Tavoy, Tenasserim, which is a little greyer on the tail and under side than in the type; also a specimen from N. Lat. 14° 25′ and E. Long. 98° 45′, to the east of Tavoy, in Siam; and one from Maw to Maw Lai in Siam, both collected by K. G. Gairdner, and another without locality obtained by the same collector. The example from Nwalabo in Tavoy shows a certain amount of grizzling on the head, tail and elsewhere and is of special interest as a connecting form between the type of *atrior* and Malayan examples of *cristatus*.

The above described British Indian subspecies of *P. pyrrhus* are all very similar in size. The dimensions in inches of a few of the largest

specimens measured in the flesh may be conveniently set forth in one table :—

Locality and Sex	Head and Body	Tail	Hind foot	Ear	Weight
shanicus					
Gokteik, N. Shan States, ♂	24	30	6½	1½	19 lbs.
,, ,, ♀	23	31	6½	1¼	15 ,,
phayrei					
Mt. Popa, Upper Burma, ♂	24	32	7	1¼	17½ ,,
,, ,, ♀	21½	31	6	1	15½ ,,
crepusculus					
Lampha, Tenasserim, ♀	22	31½	6	1¼	16½ ,
flavicauda					
Bankachon, Tenasserim, ♂	25	31	7	1¼	
,, ,, ♀	21½	30½	6½	1¼	

The recorded measurements of other specimens of these subspecies agree so closely with those quoted that it is needless to insert them in the table. Unfortunately the only available specimen assigned to *barbei* was not measured in the flesh, but the size and proportions of the skin are similar to those selected for record.

The dimensions in millimeters of some of the skulls are as follows :—

Locality and Sex	Total Length	Length of Palate	Length of Upper Molars	Orbital Width	Zygomatic Width	Height and Width of Orbit
shanicus						
Gokteik ♂	101	33	27	65	79	23 × 22
,, ♀	94	28	26	52	71	24 × 20
phayrei						
S. Zamayi, ♂	108	35	29	62	81	23 × 21
Chindwin, ♂	100	33	25	64	80	23 × 22
flavicauda						
Tenasserim Town, ♂	105	33	27	60	78	26 × 24
Bankachon, ♂	102	31	26	65	80	25 × 22
,, ♂	100	32	27	58	75	24 × 21
,, ♂	98	33	26	58	74	21 × 21
,, ♀	96	28	27	58	71	25 × 21
,, ♀	92	30	26	55	71	22 × 19
atrior						
Ye Forest, ♂	102	34	28	65	78	26 × 24
Nwalabo, ♂	—	32	27	61	76	25 × 22

These skull measurements attest general similarity in size between all the subspecies. An additional column showing the dimensions of the orbit has been added because variation in the size of the orbits has been considered to be a character of systematic importance. The orbits, for example, are larger in *atrior* than in *shanicus* or *phayrei*. In the skull of *atrior* from the Ye Forest, Tenasserim, the orbit is 3 mm. higher and 3 mm. wider than in the skull of *phayrei* from the Southern Zamayi Reserve, although the general dimensions of the skull of the latter exceed those of the former, except in the width across the orbits. And this difference in the size of the orbits gives a very different look

to the full face view of the skull, the skull with the large orbits being not only wider across the orbits but narrower between them as well, and has more prominent brow-ridges. These characters, however, like other cranial characters, are individually variable, as is clearly shown by the records of the specimens of *flavicauda* from Tenasserim. These skulls also indicate that other characters which have been relied upon are unreliable. For example, the second on the list, from Bankachon, has the palate wider and the tooth-rows more arched than the first from Tenasserim Town, whereas the fourth on the list, a younger animal, from Bankachon, resembles in these particulars the one from Tenasserim Town.

III. The Aygula-group

Differing from the *Entellus*-group and the *Pyrrhus*-group in the colour of the newly-born young which exhibits a definite pattern of white and black or brown, extending as a median spinal stripe from the back of the head on to the upper side of the tail and generally, perhaps always, passing on to the outer surface of the arms, to a greater or less extent, forming a cross-shaped mark. In the adults of most of the langurs of this group the white above and below is more or less obliterated by the extension of the black or brown pigment, but the inner side of the thigh is almost always white and sharply contrasted with the tint of the outer side. Usually there is an erect tuft of hair on the back of the head and a median whorl or a pair of whorls on the forehead. When there is a pair of whorls the hair typically rises into a crest between them. The skull is generally distinguishable from that of the *Entellus*- and *Pyrrhus*-groups by a marked convex swelling on the base of the nasal bones.

Distribution. Indo-china and the Malay Peninsula through Sumatra, Java and Borneo.

This group does not extend so far to the north as the *Pyrrhus*-group but overlaps its range in the countries above mentioned.

The name of the group is taken from a Javan species, *Pithecus aygula*, described as *Simia aygula* by Linnæus in 1758.

The precise status of the many species and subspecies of this group has not yet been ascertained. But since only one species the correct name of which appears to be *femoralis*, occurs within the area of British India, the characters of the other representatives of the group need not be considered here.

Pithecus femoralis (Horsfield), Martin.

Semnopithecus femoralis, Martin, in Charlesworth's *Mag. Nat. Hist.*, ii, p. 436, 1838 (first description of the langur named *femoralis*, but not described, by Horsfield, Appendix, *Life of Sir T. S. Raffles*, p. 642, 1830).

Semnopithecus or *Presbytis femoralis* of Anderson, Blanford and other authors, at least in part.

Semnopithecus neglectus, Schlegei, *Mus. Pays-Bas., Simiæ*, p. 47, 1876.

The whole of the upper side is dark blackish brown becoming black on the extremities of the limbs and tail ; the face is black with the lips flesh-coloured and clothed with white hair, and the eyelids also are to a certain extent pallid. The under side is also mostly blackish brown, or deep brownish grey, frequently with a white stripe extending down the chest on to the belly which tends to become lighter and may be quite white where it merges with the pubic region. The inner side of the arms is frequently pale from the axilla to the elbow and the inner side of the thighs is always clean white and this white may extend as a narrow stripe down the inner side of the leg between the knee and the heel, and on the thigh the white does not blend with the dark tint of the outer side but is sharply marked off from it by a straight white line. The under side of the tail is dark throughout like the upper.

The coat is shaggy. There is a thick erect tuft on the crown of the head and a pair of whorls on the forehead, the hair rising into a median crest between them.

Distribution. Southern Tenasserim, the Malay Peninsula, Peninsular Siam, and possibly Sumatra.

Horsfield's type of this species, an immature animal, is in the British Museum. It is labelled Sumatra but very likely came from the Malay Peninsula. At all events it very closely resembles examples from Perak, Selangore, Trang and other places in Malaya.

In addition to the typical form there are other subspecies in the Malay Peninsula and closely related species or subspecies occur in Sumatra, Borneo and the smaller adjoining islands.

Subspecies *keatii*, Rob. and Kloss.

Presbytis neglecta keatii, Robinson and Kloss, *Journ., Fed. Malay States Mus.*, iv, p. 174, 1911.

Pithecus femoralis keatii, Wroughton, *Journ., Bomb. Nat. Hist. Soc.*, May 1915, p. 702.

Very closely resembling the typical form, but with the lower side more pigmented, there being no white on the inner side of the arm between the axilla and the elbow, no white line on the chest and hardly any white on the belly which is pigmented backwards to the public region where its dark tint is strongly contrasted with the white on the inner side of the thighs.

Distribution. Tenasserim : Malewoon and Bankachon ; also Kao Wang Hip in Peninsular Siam.

In the British Museum there are examples of this subspecies, which is of doubtful value, from the above-mentioned localities.

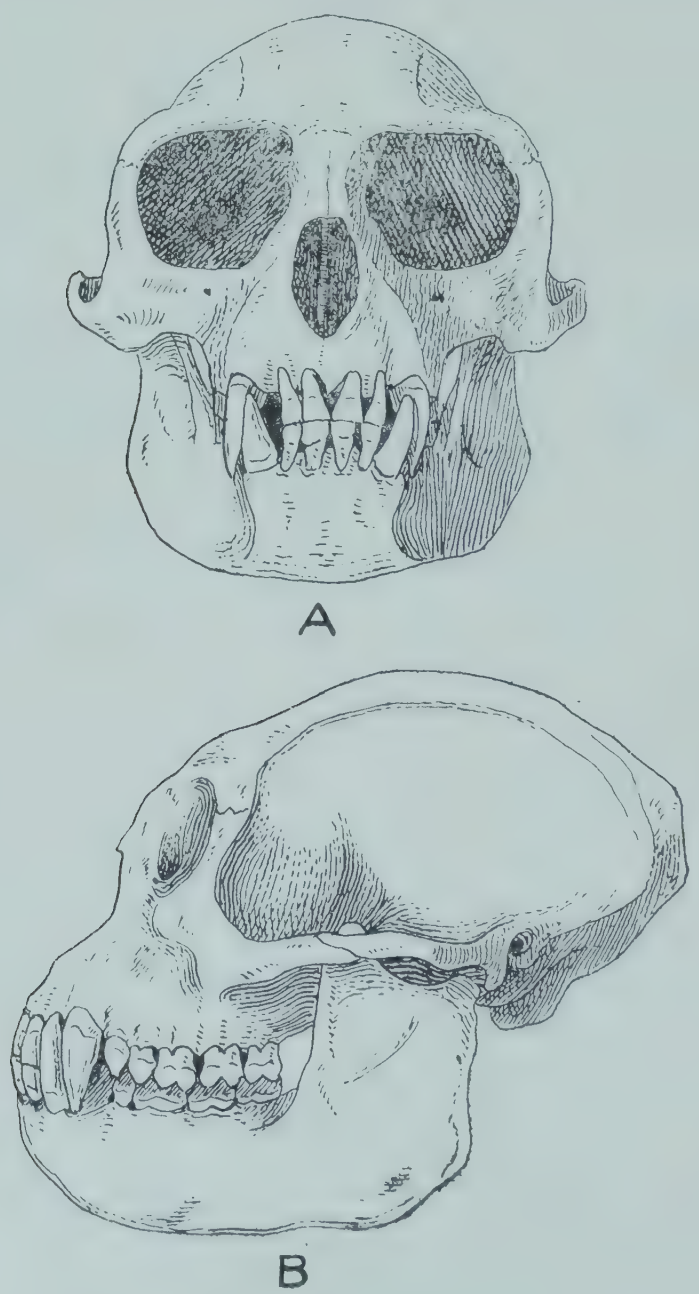


FIG. 3 A and B.—Front and side view of skull of adult male *Pithecus femoralis keatii* from Bankachon in Tenasserim.

The approximate dimensions in inches of two examples are as follows :—

Locality and Sex.	Head and Body	Tail	Hind foot	Ear	Weight
Malewoon, ♂	22+	31	7	$1\frac{1}{4}$	$15\frac{1}{2}$ lbs.
Bankachon, ♀	22	33	7	$1\frac{1}{4}$	$14\frac{1}{2}$,,

The measurements in millimetres of two skulls are :—

Locality and Sex	Total length	Length of Palate	Length of Upper Molars	Orbital Width	Zygomatic Width
Bankachon, ♂	95	28	25	64	76
Kao Wang Hip, ♀	92	28	25	62	70

(*The end*)

THE BIG BULL OF SEMBUTOLLAVU

BY

C. P. GOULDSBURY

(*With a plate*)

Short green grass in the swamps, with elephant grass—over six feet high as a rule—on the adjoining slopes, intersected here and there by small patches of jungle, the latter taken into cardamom cultivation by the neighbouring ryots—a tiny river running all along the valley—such was the home for many a year of the bull of this story.

During the dry months all the grass that would burn was set alight, but the swamps always kept their cover of green and the adjoining patches of cardamom jungle with the undergrowth alone cleared—afforded welcome shade for bison and incidentally elephant, during the scorching midday heat.

The valley in which the bison roamed was roughly five miles in length, and some two miles broad, broken up by numerous small grassland re-entrants.

From a 'spotting' point of view the country left a lot to be desired, as a herd of elephants might be, and very often was, in close proximity, to the blissful ignorance of the stalker, who would in all probability only discover it as the light was failing, and a return to camp was contemplated. On several occasions a long and tedious detour was therefore unavoidable, and with the short Indian twilight closing down suddenly into darkness, with a herd of cow elephants in the vicinity, with small calves at heel, or possibly a solitary young tusker anxious to throw his weight about, the return to camp was not always without incident.

Similarly it was inadvisable to leave camp in the mornings before the light was sufficiently strong to allow one to see at least 100 yards all round. Failure to observe this rule, resulted in a friend walking practically on to a round grey object which he took, in the early morning light, to be a rock, and which suddenly turned itself into a solitary bull elephant, and one too with an unsavoury reputation. M's retirement from the scene was rapid, and not altogether noiseless, but a nasty accident might very easily have occurred, had he actually stumbled on the animal in the half light.

Bison, of sorts, were always in the valley, but master bulls, although frequenting the entire length of it, were difficult to pick up, unless they were with the cows during the rutting season—April and May, and even during these months they would seldom lie up during the hot hours in the midst of the herd, but usually cleared off to an isolated patch of jungle soon after dawn, joining up with the cows again about dusk. At other times of the year the master bull was somewhere in the valley but, with the elephant grass, well over



THE BIG BULL OF SEMBUTOLLAVU

Tip to tip across forehead	...	75″.
Widest spread (outside)	...	43¼″.
Girth	...	20″.

ones head it was more by luck than judgment that he was ever spotted, and if he was, it was usually at dusk in the failing light, and the presence of elephants necessitated the greatest care in a stalk, even if the latter was at all possible before the light went, the almost inevitable result being that the bull was left alone that night, in the hope that he would be in the vicinity at early dawn next morning—a hope which never materialized in the many attempts I made during the hot weather months.

It was, to say the least of it, very tantalizing to get reports in from my shikaris regarding the size of one old bull bison in particular —solitary at the time—on three occasions when my men had been down they had sat on a small rocky hill looking down on the old bull who, as luck would have it, had come out to feed in a large swamp, known as Sembutollavu, at five o'clock in the afternoon.

The following two week-ends, my only chance of getting away, were spent fruitlessly in trying to get in touch with him. On one occasion he was heard moving about in cardamom jungle near the swamp, but did not come out before dark, and on the next, a solitary tusker was near the ground usually frequented by the bull, and it meant getting in between the elephant and the swamp, thereby giving my wind to what we knew was an elephant with a decided 'penchant' for chasing human beings, although at that time he had not actually been proscribed by Government as a rouge.

The close season for big game in the district of which I write, begins on May 31, and the bull being again reported near the Sembutollavu swamp, in company with eight or nine cows, my shikaris went down for four days to see if they could locate him, in which case two were to keep in touch with him, the third returning to me on the Friday. As luck would have it, the week-end fell on the last two days of the month, which would enable me if necessary to get in three stalks, Saturday afternoon, Sunday morning and evening.

At Friday midday, along came the third shikari, and his expansive grin was the forerunner to the welcome news that the bull had been seen with his cows, on the Wednesday afternoon, in Sembutollavu.

The grass on the ridge above the swamp was long, and the herd had apparently been lying out for some hours, before it actually came to the stream to drink. The men had again seen the bull on Thursday evening but this time he had evidently left the cows during the previous night, as he rejoined them from a cardamom jungle some distance away, and some time after they themselves had been out. On this particular evening the men had heard a tiger, and sent word to me that with a tiger about, it was probable that the big bull would now stay with the herd, and not leave the cows by themselves. Chances therefore of at any rate seeing him appeared good, and all arrangements were made for tents and kit to be sent down on Saturday morning.

I started for camp early that afternoon, and reached it about 3.30 p.m. after a stiff climb up one ridge, and a steep descent down another, the journey taking three hours, and the going as rough as it could be. It was a relief to eventually see the tents nestling

under a small bluff, well out of elephant country, on the edge of a stream, and a greater relief to meet Velandy, my head shikari, with the news that he had again marked down the bull, with his cows, in Sembutollavu, the previous evening.

He was very reticent regarding the size of the head, merely remarking that through the telescope it looked a good one.

A hurried tea, the heavy rifle, a double barrelled ·577 by Jeffery pulled through, and its cartridges collected, the lantern tested, and various odds and ends such as glasses, the telescope, and raincoat distributed amongst the shikaris, a move was made to the swamp, some two miles from camp.

Taking up my position with Velandy on a ridge commanding the swamp, the second shikari was posted on a small hill to my rear, to warn us in the event of elephants, which at the time were numerous in the valley, feeding out of some of the cardamom jungles and thus cutting off our return to camp at dusk.

Hardly had Velandy and I settled down when the glasses revealed seven or eight cow bison lying in high elephant grass, under some stunted thorn trees. For a long time it was difficult to pick out the bull, but Velandy at last spotted him with the telescope, lying out somewhat to our right. He was under a small tree, and beyond the colour of his hide proving him a bull, it was impossible to get a satisfactory view of his head. For over an hour we lay and watched him. Occasionly a horn would show up above the high grass as he swung his head at a tormenting fly, but before the glasses were on him, the horn would sink back again.

At last the cows appeared to be inclined to feed. One by one they got up, and moved slowly down the hill opposite us to the swamp, through which ran a small stream. Even now the high grass gave me only occasional glimpses of them, as they moved from clump to clump.

A glance at the bull, who was still lying down, and I turned back to the cows, trying to make out exactly how many there were.

Whilst watching them through the glasses I felt Velandy's hand on my knee, and the telescope was pushed towards me.

'He is up, Dorai. Look at his head.' Bringing the telescope on to the bull, I gave a gasp, and whispered to Velandy 'He is well 'over 40 inches. Why didn't you tell me when I asked you in camp.'

'I knew he was, Dorai, but if I had said so, before you actually 'saw him yourself, you would have called me a liar,' and Velandy grinned broadly at me.

The bull stood for a moment rubbing his horns against the tree under which he had been lying, and then sauntered down hill towards his cows. Even though he towered above them, it was only possible to see the ridge of his back over the elephant grass, but as he was head on, I got a very fine view of his horns through the telescope, and, in addition to their spread, the width between tips struck me as being exceptional.

The cows, seemed in no hurry to come down to me, and as it was much too far to risk a shot at the bull, covered as he was by the elephant grass, there was nothing for it but to possess my soul in patience.

As the bull closed up with the cows, the latter started grazing quietly down towards me, evidently making for a small opening in the grass at the edge of the stream, which the glasses showed me to be a ford, from the numerous tracks, and mud on the blades of grass. If they actually came down to the ford, they would be within seventy yards of my position, but from their rate of progress, this would take a considerable time, and the wind was none too steady. Above the ford and on the line they were taking was a small tree, near which the grass seemed shorter.

This I estimated to be about 120 yards from me, and after searching it carefully through the telescope, I decided to take the bull, if, and when, he got as far, and also if he turned broadside to me.

The cows were zigzagging about grazing, and I hoped, provided the wind kept steady, that the bull would give me the chance I wanted.

In the meantime I made myself as comfortable as possible, and explaining the position to Velandy, told him to watch the result of my shot when I did fire, and to be ready with spare cartridges.

After what seemed an interminable age the cows one by one, crossed the shorter strip of grass, and the bull gradually approached it. On reaching the small tree, he lay down under it. This was a shock, as I had no idea how long he proposed remaining in this position. It was quite impossible attempting to shoot as the grass though much shorter here than where I had first seen him, was still too long to enable me to get a clear sight on him, in addition to which the target had now been considerably reduced in height. Velandy suggested whistling to get him on to his feet, but in this event I was certain he would face towards me—a difficult shot to make certain of at the distance. As he lay he was broadside on, and my only hope was to cover him, and wait. The wind was fairly steady, and I got Velandy to watch him with the telescope, and tell me if he made any movement to get up. In the meantime I got ready to cover him as soon as he showed any signs of moving.

The cows were by now gradually feeding away from him, which evidently prevented him from settling down, and it was not long before Velandy whispered that he was on his knees. As his back heaved up I covered what I thought was his shoulder—the grass made things a bit difficult and holding my breath, let go at him. I felt as I pulled the trigger that I had held a little low, and let him have the second barrel as he swung round away from me, but this was a palpable miss.

The bull went up the hill, keeping the small tree between us, and showing so little the effect of the first shot that Velandy declared I had missed him. Two more barrels failed to hit him, and amidst wails from Velandy that he was a record bull, that I was wasting ammunition on him, etc., etc., I put in a last despairing shot as he was going uphill away from me, aiming between his horns, with the 200 yards leaf up, and a very full sight. He bucked to this shot, swayed, and then came rolling down the hill. There seemed no life in him through the glasses, so letting the cows—which had lumbered up the hill after the bull when I started shooting—clear

off, we went up to look at him. The grass when we got into it, was so long that we had to make a detour to the top of the ridge and then come down on the tracks made by the bull when rolling. On reaching him, a few sticks thrown at him elicited no response, but on trying to get at his head, I found this tucked under him, and impossible to move.

As the shikaris caste would no permit of their handling him, I sent the second man, who had joined us when I started shooting, to the nearest jungle for a length of green cane, which on arrival I knotted round a hind leg, telling the men to heave at the other end. This was almost too successful, as the slope of the ground very nearly brought the bull on top of us. However it had the desired effect of releasing his head, and I gave another gasp when I put the tape on it. The widest spread outside showed 43¼ inches. Girth 20 inches, tip to tip between horns 34 inches, tip to tip of horns across the forehead 75 inches, and length on outside curve of longer horn 30¾ inches.

My first shot was low down behind the shoulder, and my exceedingly lucky last one had caught him near the spine, forward of the rump, and as we discovered later, had travelled, and set up in the lungs.

In addition I cut a spherical 12-bore bullet out from just under the skin of the flank --a bullet evidently fired into him from a shot gun, by a cardamom ryot, most of whom own guns, ostensibly to protect themselves from wild elephants.

As it was then getting dark, and elephants were about, we left the bull where he lay, to return and secure the head and mask early next morning.

My return to camp was with mingled feelings. Joy at having outwitted the old bull predominated, but at the same time there was the inevitable feeling of sorrow that he would roam his territories no more. In this particular case, not a vestige of his enormous body was to be wasted, as a pencilled chit from camp to a friend on a neighbouring estate, early the following morning, produced an incredible number of pariah coolies, and the head and mask being removed, I left for my bungalow knowing that it would not be long before every particle of meat, including the intestines, would be on its way to gladden the hearts, and soothe the insides, of numerous coolies, and provide them with at least one square meal.

The accompanying photograph gives a good idea of the bull's head and also of the flies that discovered him, though these proved no deterrent to the swarms of coolies that later got down to work on him.

A curious feature was the presence of raw red spots each the size of half a crown on all four legs of the bull from ' stocking ' to fetlock. These were denuded of hair and were raw though not actually bleeding.

INDIAN DRAGONFLIES

BY

LT.-COL. F. C. FRASER, I.M.S., F.E.S.

Part XXX

(*With three plates*)

(*Continued from page 459 of this Volume.*)

Genus—MICROMERUS, Ramb.

Micromerus, Ramb. Ins. Nevrop. p. 238. (1842) ;—Selys., Syn. Cal., p. 64 (1853) ;—Id. Mon. Cal. p. 233 (1858) ;—Walk. List. Neur. B. M. iv, p. 652 (1853) ;—Kirby, Cat. Odon., p. 115 (1890) ;—Will. Proc. U. S. Nat. Mus. vol xxviii, p. 172 (1904) ;—Ris. Ent. Mitteil. V. Nr. 9/12 (1916).

Characters as for the subfamily, the epistome however, much more developed than in *Rhinocypha*, much more projected, so that a deep fissure intervenes between the frons and nasus. Fore and hind-wings similarly shaped, very long and narrow, reticulation moderately open ; fore-wings of male, in most species, tipped with black, otherwise all wings of both sexes completely hyaline (except in *snellemani* and *bisignatus*, both ex-Indian species, in which the wings are marked with broad blackish brown fasciæ as found in many species of *Rhinocypha*) ; antenodal nervures 4 to 7 in number ; sectors of arc arising from a common point, where the arc is strongly angulated at a little above its middle ; *IA* undulated from its origin ; petiolation ends proximad of the first antenodal nervure ; intercalated nervures few in number and found only near apices of wings ; *Riii* arising widely distad of node ; pterostigma absent in forewings of male except in those species where the apices are not tipped with black, present and very elongate in the hind, and in all wings of the female.

Mesothoracic triangle absent or reduced, uncoloured ; legs long and slim, usually all femora and tibiæ pruinosed white on the flexor surfaces. Abdomen short and stout, much shorter than wings, fusiform, depressed, narrowing very gradually towards the 10th segment. Anal appendages very similar to those of *Rhinocypha*, superiors twice the length of segment 10, pincer-like, cylindrical and pointed at apices ; inferiors obtuse, less than half the length of superiors. Vulvar scale very robust, shaped as for *Rhinocypha*.

Larva very similar to that of *Rhinocypha* (*vide* Plate III.)

Distribution. Southern Asia from Western India to Borneo and New Guinea. Most Indian species appear to have origin from *lineatus*, which is only found typically from Lower Burma within Indian limits. Elsewhere it comes from Java and Siam, several subspecies or races occurring throughout Burma, Continental India and Ceylon. In the latter island, due to insulation, we find a surprising development of the genus, the species found there not being apparently closely related to *lineatus*.

Their habits do not differ in any respects from those of *Rhinocypha*, and they are found in similar habitats.

Genotype—*Microm rus lineatus* Burm.

The present position of the nomenclature of *Micromerus* and *Libellago* is uncertain. The first mention of the latter genus is found in Selys, *Mon. Lib. Eur.* p. 200 (1840), wherein he gives a short description of the genus and cites *Agrion lineata* as the genotype, but also gives *fenestrata* and *fulgipennis* (now classed as *Rhinocypha*, but at that time as *Agrion*.) as belonging to the same genus. *Lineata* had however been described by Burmeister as a *Calopteryx* and Selys committed an error in assigning it to *Agrion*. That he did so is perfectly clear, from the fact that he refers to the *Mon. Lib. Eur.*, when describing genus *Micromerus* in the Mon. Cal., p. 233. It seems perfectly clear therefore that *lineata* as referred to in the *Mon. Lib. Eur.* was Burmeister's *Calopteryx lineata* (*Micromerus lineatus*), and equally clear that it was given

as the genotype for *Libellago*, and this being the case, *Micromerus* becomes a mere synonym for *Libellago*, and the latter name, for what it now stands, is therefore preoccupied. As I have already committed myself, in the present Monograph, to the present use of the names, a change of seats in midstream might cause endless confusion and I have therefore decided to let things stand as they are. In a future revision however, it will beeome necessary to rectify these errors. *Micromerus* becoming *Libellago* and a new name being chosen for the latter, for which I would suggest *Chlorocypha*.

Key to Indian species of *Micromerus*.

1.	Abdomen marked with bright orange or brick-red...	2
	Abdomen marked with bright citron yellow or greenish	3
2.	Greater part of abdomen bright orange ; middorsal carina of abdominal segments not marked with black. (Burma.)	*M. aurantiacus.*
	Abdominal segments bearing large spots of brick-red ; dorsal carina of all segments black. (Ceylon.)	*M. greeni.*
3.	Male with 6 antenodal nervures to all wings ...	4
	Male with 5 antenodal nervures. (Burma, N. India.)	*M. lineatus lineatus.*
4.	Black tip to forewings of male 4 to 5 mm. in length.	5
	Black tip to forewings of male only 3 mm in length.	6
5.	Humeral stripe present at its middle ; posterior lobe with a large dorsal spot ; thoracic markings orange. (Nicobars.)	*M. blandus.*
	Humeral stripe absent ; posterior lobe of prothorax unmarked ; thoracic markings citron yellow or green. (Andamans)	*M. andamanensis.*
6.	Small insects, hindwing less than 18 mm. in length ; linear spot on hinder border of occiput with a median anterior prolongation ; abdominal markings citron yellow (Continental India and Ceylon.)	*M. lineatus indica.*
	Larger insects with hindwing more than 20 mm. in length ; linear spot on hinder border of occiput without median prolongation ; abdominal markings bluish or bluish-green. (Ceylon.) ...	*M. finalis.*

Micromerus lineatus lineatus, Burm. (*Calopteryx lineata* Burm.) Handb. Ent. ii, p. 826 (1839),—Selys. (*Agrion lineata*) Mon. Lib. d'Europe, p. 200 (1840),—Ramb. (*Micromerus lineatus*) Ins. Nevrop., p. 238 (1842),—Selys. Syn. Cal., p. 65 (1853),—Id. Mon. Cal., p. 237 (1858),—Id. Bull. Acad. Belg. (2), xxvii, p. 665 (1869).—Walk. (*Libellago lineata*) List. Neur. Ins. B. M., p. 653 (1853),—Ramb. l. c. (*Micromerus uxor*) p. 239 (1842),—Kirby Cat. Odon. p. 115 (1890),—Selys. Ann. Mus. Civ. Genov. (2) x (xxx), p. 62 (1891).—Laid. Fascic. Malay. (Zool), pt. 1, p. 197 (1903),—Will. Proc. U.S. Nat. Mus., vol. xxviii, p. 171, figs. 5 and 6 (1904),—Laid. Rec. Ind. Mus., vol. xiii, p. 39 (1917),—Fras. *Ibid.*, vol. xxvi, p. 483 (1924).—*Micromerus obscurus*, Kirby Proc. Zool. Soc. Lond., p. 328 t. 33, f. 1(1886).—Id. Cat. Odon., p. 115 (1890).

Male. Abdomen 15 mm. Hindwing 17 mm.

Head. Labium dull brownish yellow to blackish ; labrum blackish brown, the anterior border finely yellow ; epistome black, the anterior facet blue black metallic, above velvety black ; frons and vertex velvety black—with 2 transverse oval citron yellow spots on former near middle line and a large oval spot on outer side of each posterior ocellus ; occiput black with a large postocular spot subtriangular in shape, on each side separated from, more or less narrowly, a median crown-shaped spot. The latter spot rather variable, in the type, transversely elongate with a median spot in front of its middle, but in others, confluent with this spot and with additional triangular points on either side.

Prothorax black marked with citron yellow as follows :—The border of the posterior lobe very finely except below where it is expanded into a pyriform

spot ; a large transversely oval spot on dorsum of posterior lobe, this part being raised into an oval boss coated with fine hairs ; a narrow anterior collar, and a large subtriangular spot on each side of middle lobe.

Thorax black marked with citron or greenish yellow as follows :—The whole of antealar sinus, the middorsal carina finely, a narrow ragged antehumeral stripe incomplete above, a small upper antehumeral spot, a norrow curved posthumeral stripe incomplete below. Laterally nearly the whole of the mesepimeron which shows a narrow wedge of black at its middle and a hook-shaped or triangular-shaped invasion of black above ; lastly the whole of metepimeron except the anterior sutural line and the ventral border narrowly. Beneath yellow.

Legs black, flexor surfaces of tibiæ and of the anterior pair of femora pruinosed white.

Wings hyaline, the bases of all, nearly to level of node, palely tinted with amber ; the apices of forewings (except in tenerals where no marking is visible) tipped with black as far proximad as inner end of pterostigma of hindwing but falling short of hinder border of wing. Pterostigma absent in forewing, black tumid and elongate in hindwing where it covers from 2 to $2\frac{1}{2}$ cells. Costa of forewing gradually thickened towards the site where pterostigma would ordinarily be ; discoidal cell traversed once ; nodal index, 5 antenodal nervures, 8 to 10 postnodals.

Abdomen black and bright greenish or golden yellow, the latter colour prevailing on the anterior segments, the former on the hinder. Segment 1 with the apical border narrowly and the sides broadly yellow, segments 2 to 5 with the latero-ventral borders and the intersegmental sutures narrowly black, the carina also finely black from segment 2 to 4, or in tenerals from 2 to 6, but arrested short of apical border where the black expands or is connected to two wing-like projections, so that this together with the carinal stripe form inverted capital ' Ts ' (in some specimens, the arms of the ' T ' are slightly separated from the stem, but this is rare). Segments 5 and 6 with two large dorsal yellow spots tapering apicad, enclosed by an expansion and confluence of the carinal T-spot with the apical ring and latero-ventral black ; segments 7 and 8 may show smaller similar spots, but adults have these unmarked, as also 9 and 10.

Anal appendages black, superiors twice the length of segment 10, separated widely at base, converging at apices which are turned slightly in, cylindrical and very slightly tapered. Inferior appendages only half the length of superiors, closely apposed at bases and again at apices so as to enclose a minute foramen, blunt, broad at base, narrowed thereafter.

Female. Abdomen 13 to 16 mm. Hindwing 18 to 22 mm.

A stouter, more robust insect than the male, marked very similarly but the yellow more extensive.

Head with the same markings as for male but with the following additional spots :—The labrum and labium, the former with a small basal median tongue of black ; the anterior surface of epistome (which in the male is metallic blue) ; the bases of mandibles, cheeks, basal joints of antennæ, a large spot on either side of epistome and two large diamond-shaped spots on front of frons, narrowly separated from the smaller hinder pair.

Prothorax, thorax and legs as for male.

Abdomen black marked with yellow as follows :—The apical border and sides of segment 1 ; the dorsal carina on segments 2 to 7 ; a longitudinal stripe on dorsum of 8 and 9, whilst that of 10 is unmarked. Laterally the segments yellow with a large apical spot notched in front on segments 2 to 7, bifid on segment 8, and present only as a small yellow spot on sides of 9 and 10. (Briefly the abdomen may be said to be yellow with two longitudinal bands of black and black articular rings at the intersegmental nodes.)

Anal appendages black, twice as long as segment 10, pointed, widely separated throughout. Legs black, the flexor surfaces of femora and tibiæ yellow.

Wings entirely hyaline, the basal area, especially along the costa slightly tinted with amber ; pterostigma, present in all wings, elongate, black or yellow framed in black according to age, covering 2 or 3 cells ; 6 antenodal nervures, 9 to 10 postnodals.

Distribution. Throughout the Sondaic Archipelago and the adjacent mainland, Java, Sumatra, Siam, Annam, Burma and North India. Kirby's *obscurus*, described from a teneral specimen, from northern India, is identical to specimens which I have received from Dehra Dun, Cachar and Upper Burma. It

differs only in the limitation of black markings due to tenerality and is undoubtedly *lineatus*. In Peninsular and Southern India we find a distinct subspecies replacing typical *lineatus*, which I have named *indica*. The two Ceylon forms show sufficient differences as to deserve specific rank.

Micromerus lineatus indica, subsp. nov. (*Micromerus lineatus*) Fras. Rec. Ind. Mus., vol. xxvi, p. 483 and pl. xxiv, fig. 4 (1924),—Laid. *Spolia zeylanica* (*M. lineatus*, Burm.), vol. xii, part 47, pp. 354, 355 (1924).

Male. Abdomen 14 to 16 mm. Hindwing 15 to 18 mm.

Head very similar to that of *lineatus*, labium ochreous, labrum dark brownish yellow, black at base; a more or less obscure spot on either side of epistome, the anterior facet of which is metallic blue as in *lineatus*; eyes brown but with a bluish metallic lustre in certain lights; bases of mandibles and cheeks narrowly yellow; the oval spots on frons reniform in shape and often a second pair of smaller rounded spots behind them; crown-shaped mark on occiput with an elongate median point, but no lateral points, or if present then very short, usually connected to the postocular spots.

Prothorax, thorax and legs as for type *lineatus*, the femora pulverulent white at basal halves only.

Wings as for *lineatus* but the apical black spot of forewings distinctly longer (absent in tenerals); nodal index differing slightly, in Kanara specimens 6 antenodals in the forewings, 7 in the hind, less commonly 5 to 6 in the hind; in Deccani specimens, almost always 6 in both wings and 10 to 14 postnodals. The amber tinting at base usually very marked, upto or even beyond node; discoidal triangles traversed once; pterostigma as in *lineatus*.

Abdomen. (As in *Libellago*, so in *Micromerus* specialization seems to have confined itself almost entirely to the colouring and markings of the abdomen.) Segment 1 bright golden yellow with the base narrowly and a small quadrate black spot; segments 2 to 6 bright citron yellow, the dorsum golden green, often very green, 2 with a thick middorsal dumb-bell-shaped black marking confluent with a narrow basal ring, the ends of which are prolonged along the sides nearly to apical border, and separated very narrowly from the ventral border, segments 3 to 5 with broad middorsal stripes confluent with narrow basal rings and expanded somewhat apically, whilst laterally near the apical border, a small ventro-lateral spot of black is seen; segments 6 and 7 with basal subdorsal wedge-shaped yellow spots enclosed by a fusion of the middorsal black with an elongated lateral spot, segments 8 to 10 black. In some specimens the middorsal marking of segment 2 is narrowly bisected with yellow, and there is nearly always an indication of the beginning of such a line apicad.

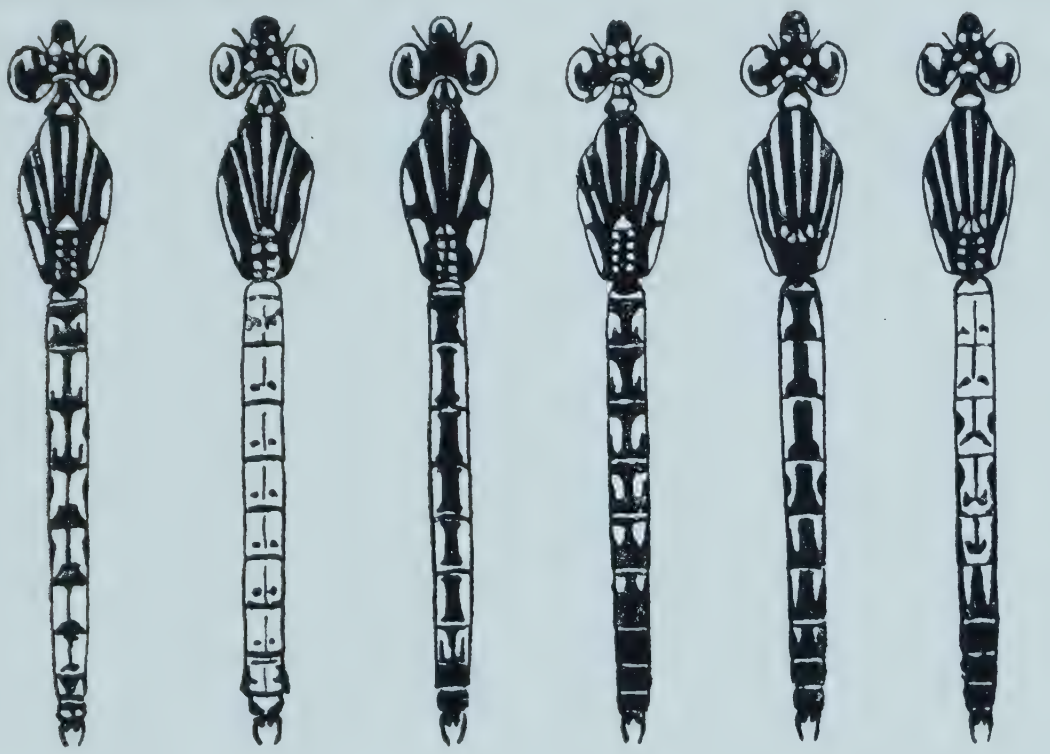
Anal appendages not differing from *lineatus*.

Female. Abdomen 13 to 17 mm. Hindwing 17 to 20 mm.

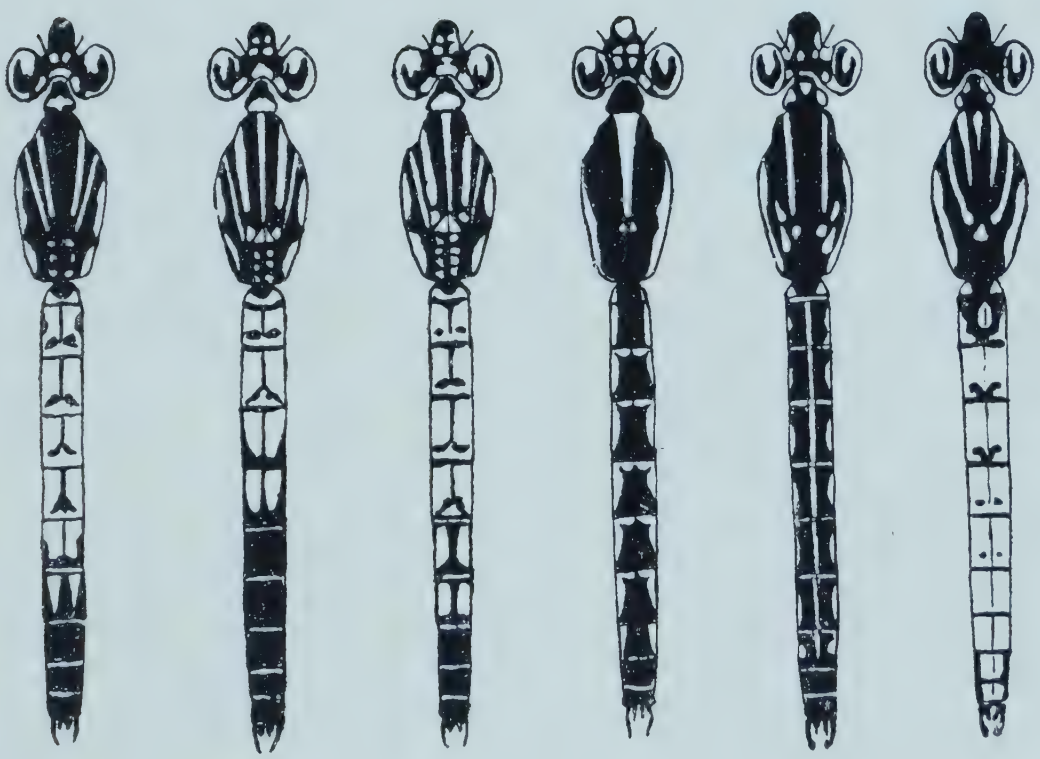
Head. Labium yellow; labrum yellow with a small median basal point or tongue of black; epistome entirely yellow in front, similarly coloured above but here edged with black anteriorly and laterally, its dorsum clouded with light brown and the base narrowly dark brown with a tongue of the same colour running obliquely forwards and outwards; frons with two large quadrate citron yellow spots, separated narrowly by a black median stripe which is confluent anteriorly and posteriorly with an equally narrow black stripe, the whole thus forming a black anchor-like mark, accentuated by the outer corners of the hinder portion angulated forwards like the flukes of an anchor; markings of rest of head similar to those of male but an additional pair of spots situated between ocelli. Eyes brown.

Prothorax entirely similar to the male. Thorax similar but lateral markings rather more extensive. Legs yellow, the femora lined externally with dark brown.

Abdomen largely yellow with black markings as follows:—Segment 1 with a large quadrate spot on dorsum, the base narrowly and the apical border laterally; segment 2 to 8 with the dorsum very broadly but bisected by a narrow middorsal carinal yellow line which runs as far as segment 9, but on the last two segments is fusiform, tapering apically and basad; laterally a stripe more or less defined, broadening abruptly subapicad and not quite reaching the base of segments. On segment 9 this line expands basad and becomes confluent with the dorsal black to enclose a large rounded subdorsal yellow spot, segment 10 black with two transversely elongate subdorsal yellow spots.



1 2 3 4 5 6



7 8 9 10 11 12

FIG. 1. *Micromerus greeni*, Laid. (Ceylon.)
,, 2. ,, *aurantiacus*, Selys. (Burma.)
,, 3. ,, *andamanensis*, Fras. (Andamans.)
,, 4. ,, *finalis*, Selys. (Ceylon.)
,, 5. ,, *lineatus indica*, subsp. nov. (Kanara.)
,, 6. ,, ,, *lineatus*, Burm. (Dehra Dun.)
,, 7. ,, ,, ,, ,, (Cachar.)
,, 8. ,, ,, ,, ,, (Java.)
,, 9. ,, ,, ,, ,, (Siam.)
,, 10. *Calocypha laidlawi* (Fras.) (Kanara.)
,, 11. *Libellago asiatica*, Selys. (Burma.)
,, 12. ,, *curta*, Selys. (Uganda.)

Wings hyaline palely amber tinted ; pterostigma present in all wing, creamy white in a black frame which expands somewhat proximad, over 2 cells ; nodal index,—6 to 7 antenodals. 9 to 10 postnodals ; discoidal cell traversed once in all wings.

Anal appendages blackish brown, pointed, tapered, widely divaricate, rather longer than segment 10.

Vulvar scale robust, with a large spot of yellow laterally.

Distribution. A very common insect throughout South India especially in the Western Ghats and Deccan. It is common on the river banks at Poona and Khandala, less common in Coorg, Kanara and Malabar.

Laidlaw reports it from Ceylon, Haragama, July, and remarks on its difference from type *lineatus lineatus* Burm., from Burma and Siam.

It appears to be double-brooded, as it may be found pretty well throughout the year. The abdominal markings will easily distinguish it from typical *lineatus*. Type and co-type in B. M. from Poona.

Micromerus lineatus blandus Selys, Syn. Cal., p. 64 (1853) ;—Id. Mon. Cal., p. 254 (1854) ; Walk. (*Libellago blandus*) List. Neur. Ins. B. M. iv, p. 652 (1853) ;—Laid. Rec. Ind Mus., vol. xiii. p. 39 (1917).

Male. Abdomen 17–18 mm. Hindwing 20–21 mm.

Female. Abdomen 12–15 mm. Hindwing 19–21 mm.

I have not seen this species, which in the Selysian description is said to closely resemble *lineatus*, a fact which leads me to describe it as a subspecies of the typical form from Java.

It is a more robust insect and differs from *lineatus* as follows :—

The yellow stripe on the cheeks bordering the eyes absent ; prothorax black, its middle lobe unmarked but the large dorsal tumid spot on the posterior lobe extending forwards as a point ; thoracic markings more orange than yellow ; the humeral stripe incomplete above and below, present in its middle third only; the anterior of the two broad lateral fasciæ broken up into three large spots, the upper very minute ; dorsal markings of abdomen broader ; apical black spot of forewings longer than broad, about 4 mm. in length ; pterostigma longer, covers about 5 cells in the hindwings ; 6 antenodal nervures in all wings.

Female very similar to that of *lineatus*. The yellow markings more restricted the humeral stripe absent, the anterior of the two lateral fasciæ divided up into two spots ; the dorsal black of segments 3 to 6 narrower, nearly interrupted on some, ground colour orange ; nodal index higher, 14 postnodal to hindwings, 12 to the fore ; pterostigma yellow, black, proximad, broader, over 3 to 5 cells.

Distribution. Confined to the Nicobars. Type in the Selysian coll.

Micromerus andamanensis, Fras. Rec. Ind. Mus., vol. xxvi, p. 410 (1924).

Male. (Female unknown,) Abdomen 16 mm. Hindwing 20 mm.

Head. Eyes bluish grey ; labium and labrum black ; rest of head jet black with the following citron yellow markings ;—two narrow oval spots at base of epistome above, a large oval spot on the outer side of each posterior ocellus, a similar postocular spot on each side, and a linear spot on the hinder border of occiput.

Prothorax black with a large yellow spot on each side.

Thorax black marked with golden greenish yellow as follows, two small spots on the antealar sinus, a fine carinal dorsal line, two fine antehumeral stripes incomplete above, an oblique linear spot on each side of the antealar sinus. Laterally two irregular spots lying between the lateral sutures, the anterior golden yellow, the posterior distinctly greenish, and a broad stripe occupying the upper anterior three-fourths on the metepimeron.

Legs black, the hinder tibiæ pulverulent white on the flexor surface. Wings hyaline, faintly amber tinted at bases, forewings broadly tipped with black to 4 mm. in extent and metallic blue by reflected light ; hindwings enfumed at apices ; pterostigma black, only present in hind wings ; 5 to 6 antenodal nervures in all wings.

Abdomen golden yellow marked with black as follows :—Segment 1 narrowly black at base, more broadly at sides ; segment 2 with a broad dorsal stripe expanded at basal and apical ends of segment, also a broad black stripe low down on sides not extending as far as apical border of segment ; segments 3 to 6 with broad middorsal stripes expanded only at apical border of segments

where it forms a narrow ring ; segment 7 similar but on the sides, the apical black extending forwards nearly as far as base of segment ; segments 8 to 10 entirely black.

Anal appendages black, similar to those of *lineatus*.

Distribution. Andamans, the type, a male, is in the Indian Museum, and was taken by the late Dr. Annandale on the Western slopes of Mt. Harriet, November 30, 1923(fluttering over the surface of a pool below a waterfall). Altitude 500 ft. This very beautiful insect is easily distinguished by the broad metallic blue tip to its wings, as well as the extreme grade of melanism as compared to other species of the genus, it is to be hoped that some collector on the spot will find the female for us. It should not be difficult to secure a fine series as most species are usually abundant where taken. The female is probably very similar to *lineatus* and without a black tip to her wings.

Micromerus finalis Selys, Bull. Acad. Belg. (2) xxvii, p. 665 (1869),—Id. *Ibid.*, xxxvi, p. 616 (1873),—Kirb,. Cat. Odon. 115 (1890),—Id. Journ. Linn. Soc. (Zool) vol. xxiv, p. 556 (1894),—Laid., *Spolia zeylanica* vol. xii, part 47, pp. 351–352 (1924).

Male. Abdomen 16 mm. Hindwing 21 mm.

Head. Labium yellow, lobes tipped with black ; labrum glossy black, unmarked ; epistome metallic blue or violety blue ; cheeks with a narrow yellow stripe against the eyes ; frons black with a pair of large rectangular spots of citron yellow ; vertex black with an oval citron yellow spot on the outer side of each posterior ocellus ; occiput black with a rounded postocular spot on each side and a linear spot along the hinder border, narrowly separated from the former.

Prothorax black marked exactly as in *lineatus*, but the anterior of the two lateral fasciæ with a large black spot below. Beneath black marked obscurely with dark yellow areas.

Legs black, all tibiæ pulverulent white on flexor surfaces and all femora pulverulent on same surfaces except for a short distance at the distal extremities.

Wings hyaline palely amber tinted, especially the hinder ; forewings tipped with black for about 3 mm., pterostigma absent ; hindwing with well-formed elongate pterostigma, covering 3 cells ; 6 antenodal nervures in all wings, 10 postnodals in the hind ; discoidal cell traversed once in all wings.

Abdomen black marked with bright citron yellow laterally, changing to green or bluish-green on dorsum. Segment 1 with the base narrowly and the sides broadly black ; segment 2 with a large angulated subdorsal spot on either side, the black forming a large T-shaped mark on dorsum, base, and sides where the arms of the T turn back ; segments 3 to 4 very similar but the head of the T-shaped mark very narrow, as also its lateral prolongations back, and on the sides of the latter segment, the beginnings of a narrow lateral stripe apicad ; segment 5 to 7 with subdorsal elongated spots divided, except on segment 5, by a narrow lateral black stripe ; segments 8 to 10 unmarked.

Anal appendages black, similar in structure to those of *lineatus*.

(The female has not hitherto been described.)

Female. Abdomen 16 mm. Hindwing 25 mm.

Head black marked with bright yellow ochre as follows —the labium except for the tips of lobes ; the labrum except for the base which is narrowly black and the border which is broadly black, and also a triangular prolongation from the middle of the basal black which may be confluent with that of the fore-border. (In very adult specimens, the yellow reduced to two minute points) ; a pyriform spot on the dorsum of epistome, reduced in adult specimens to a tiny linear mark. (The anterior facet of epistome metallic blue, but more dully so than in male) ; the bases of mandibles broadly yellow, the basal segments of antennæ, the cheeks, two pairs of spots on frons in front of ocelli, an oval spot on outer side of each hinder ocellus and similar spots on occiput as in male. (In very adult specimens, these spots reduced to mere points, and the median linear spot on hinder border of occiput entirely absent.)

Prothorax black with a linear or top-shaped spot on middorsum of posterior lobe and a large spot on the sides of mid-lobe.

Thorax black marked very much as in the male but the markings more restricted. The antealar sinus with two small yellow spots, the middorsal carina very finely, the humeral stripe either absent or represented by a chain of small





Two views of the River Cauvery, Coorg-Mysore Frontier; favourite haunts of *Micromerus lineatus indica* and *Rhinocypha bisignata*. Other species taken here include *Mesogomphus lineatus*, *Macromia cingulata* and *indica*, *Macromidia donaldi*, *Onychothemis testacea*, *Zygonyx torrida isis*. *Chloroneura apicalis* and *quadrimaculata* were found here also, the former lurking under the bigger trees, the latter perched on bare rocks in mid-stream.

spots, or a tiny linear upper spot ; the lateral fasciæ similar or the anterior one bisected below and completely cut in two at its middle, the upper portion more or less obsolete. Beneath brownish yellow with the sutures diffusely black.

Legs yellowish, black externally, the hinder pair of femora bright yellow except at the distal ends.

Wings palely tinted and enfumed, the hinder pair occasionally tipped narrowly and diffusely with blackish brown ; pterostigma creamy white framed in black and clouded with black proximad ; discoidal cells traversed once or twice ; 7 antenodal nervures to all wings, 11 to 13 postnodals.

Abdomen black marked with bright citron yellow or greenish yellow as follows,—the middorsal carina narrowly from segment 2 to 8 ; segment 1 as for male, segments 2 to 8 with broad lateral stripes constricted subapicad, markedly on segments 2 and 3, less so on 4 to 6, tapered apicad on segment 7 and broadening apicad on segment 8 ; a large round spot replacing this stripe on segment 9, and a smaller spot on segment 10, absent in very adult specimens. A chain of broad yellow spots on ventrum. Vulvar scale robust, shaped as for *lineatus*.

Anal, appendages black, conical, pointed at apices, twice the length of segment 10.

Distribution. Confined to the montane and submontane districts of Ceylon. Col. F. Wall took a fine series at Banderawela and Nalande, the former 5,000 ft., during October, but it probably has a succession of broods throughout the monsoons. I took this species in August at Dyatalava, and Col. Wall and Mr. E. Green at Kandy, 2,000 ft. October–November.

Micromerus greeni, Laid. *Spolia Zeylanica*, vol. xii, part 47, pp. 352–354 (1924).

Male. Abdomen 14 mm. Hindwing 17–19 mm.

Head black marked with bright ochre as follows :— Labium entirely black ; labrum glossy black, unmarked ; epistome black, its anterior facet bluish-violet metallic ; frons with a single pair of spots, less commonly a second pair of very minute points posterior to anterior pair ; an oval spot on the outer side of each hinder ocellus, a rounded postocular spot on each side of occiput and a linear spot along its hinder border, which in some, has a tiny medial point anteriorly ; the cheeks with a narrow yellow bordering against the eyes.

Prothorax black marked with citron yellow as follows : —a narrow anterior collar followed laterally by a small spot and then a large medio-lateral subtriangular spot. A large spot on the dorsum of posterior lobe shaped like the ace-of-clubs, and two smaller spots low down on its sides.

Thorax black marked as for *lineatus* but the markings more reduced as follows,—the humeral stripe present only as a tiny upper linear spot, the antealar sinus with two small rounded spots, the upper part of the anterior lateral fascia tapered away above and shaped like a sickle, the second or hinder fascia framed heavily in black. Beneath black.

Legs black, all tibiæ pulverulent white on flexor surfaces, all femora pulverulent creamy yellow on distal halves of flexor surface.

Wings hyaline palely tinted with yellow, the hind palely enfumed, the apices of forewings tipped with black for about 3 mm. and with a more or less marked metallic lustre at this part ; the hinder with apices clouded with black at extreme border. Pterostigma present only in hindwings, covers 3 to 3½ cells, black. Costa proximad to node, and the nervures behind it, bright blood-red, this colour less marked in the hindwing and darkening proximad. Discoidal cells with one traversing nervure ; 6 antenodal nervures in all wings, 10 to 12 postnodals in hindwings.

Abdomen black marked with bright citron yellow and blood-red as follows,—segment 1 with an apical ring of citron yellow broadening laterally ; segment 2 with a large subdorsal spot not reaching the basal extremity and constricted near its apical end, citron yellow ; segment 3 with a broader spot citron yellow tinged with reddish, extending from base to apex of segment and abruptly narrowed subapicad and, partially divided by a narrow longitudinal black stripe running from its apical end ; segments 4 to 10 with the markings blood- or brick-red, broad paired spots separated by the black dorsal carina, constricted at the apical end and not quite reaching the apex of segments, thus forming rather narrow inverted black capital T-like markings on each segment. Segments 9 and 10 with only a small round apical spot on each side.

Anal appendages black, rather slenderer than in other species, twice as long as segment 10.

(The female has not hitherto been described.)

Female. Abdomen 12 to 13 mm. Hindwing 19 to 20 mm.

Head marked very similarly to the male, differs as follows :—Labrum with a pair of large triangular yellow spots ; epistome with a metallic colouring poorly developed ; two small linear spots on dorsum of epistome, obsolete in very adult specimens ; bordering medial spot on occiput absent.

Prothorax black with a narrow linear medial stripe on dorsum of posterior lobe, a large spot low down on its sides, a large spot on each side of medial lobe and, rarely, a fine anterior collar.

Thorax black marked exactly as for male, but in very adult specimens, with the antero-lateral fascia cut in to two spots at its middle.

Legs black, some slight pruinescence on the flexor surface of femora, and the same surface on anterior pair of tibiæ pulverulent creamy white except at distal ends.

Abdomen black marked with citron yellow, with a greenish tinge on the anterior segments as follows :—Segment 1 with a lateral quadrate spot ; segments 2 to 8 with the middorsal carina finely yellow and with lateral stripes, which are constricted apicad on segments 2 to 5, tappered on 6 and 7, reduced to a spot on the others or, in very adult specimens absent on segments 9 and 10, less often on segment 8 and rarely present on segment 10.

Anal appendages and vulvar scale as for *lineatus*.

Wings hyaline, not enfumed or tinted ; 5 to 6 antenodal nervures, 10 to 12 postnodals in all wings ; discoidal cell traversed once ; pterostigma white framed in black and clouded at its proximal end.

Distribution. Col. F. Wall took a number of these insects at Nalande, Ceylon, during September and October, whilst Mr. E. Green took specimens at Haragama, Peradeniya and Kandy from June to December, so that it appears to have a long season like most species of the genus. It closely resembles *M. aurantiacus*, but the black markings are more extensive. Easily distinguished from all other species by its red abdomen, strongly reminescent of the African Libellagos.

Micromerus aurantiacus, Selys, Bull. Acad. Belg. (2), xvii, p. 448 (1859),—Id. *Ibid.*, (2), xlvii, p. 397 (1879),—Kirby, Cat. Odon., p. 115 (1890),—Laid. *Proc.* Zool. Soc. Lond., p. 331 Sept. (1920),—Will. Proc. U. S. Nat. Mus., vol. xxviii, p. 172, fig. 7 (1904).

Male. Abdomen 12–15 mm. Hindwing 15–16 mm.

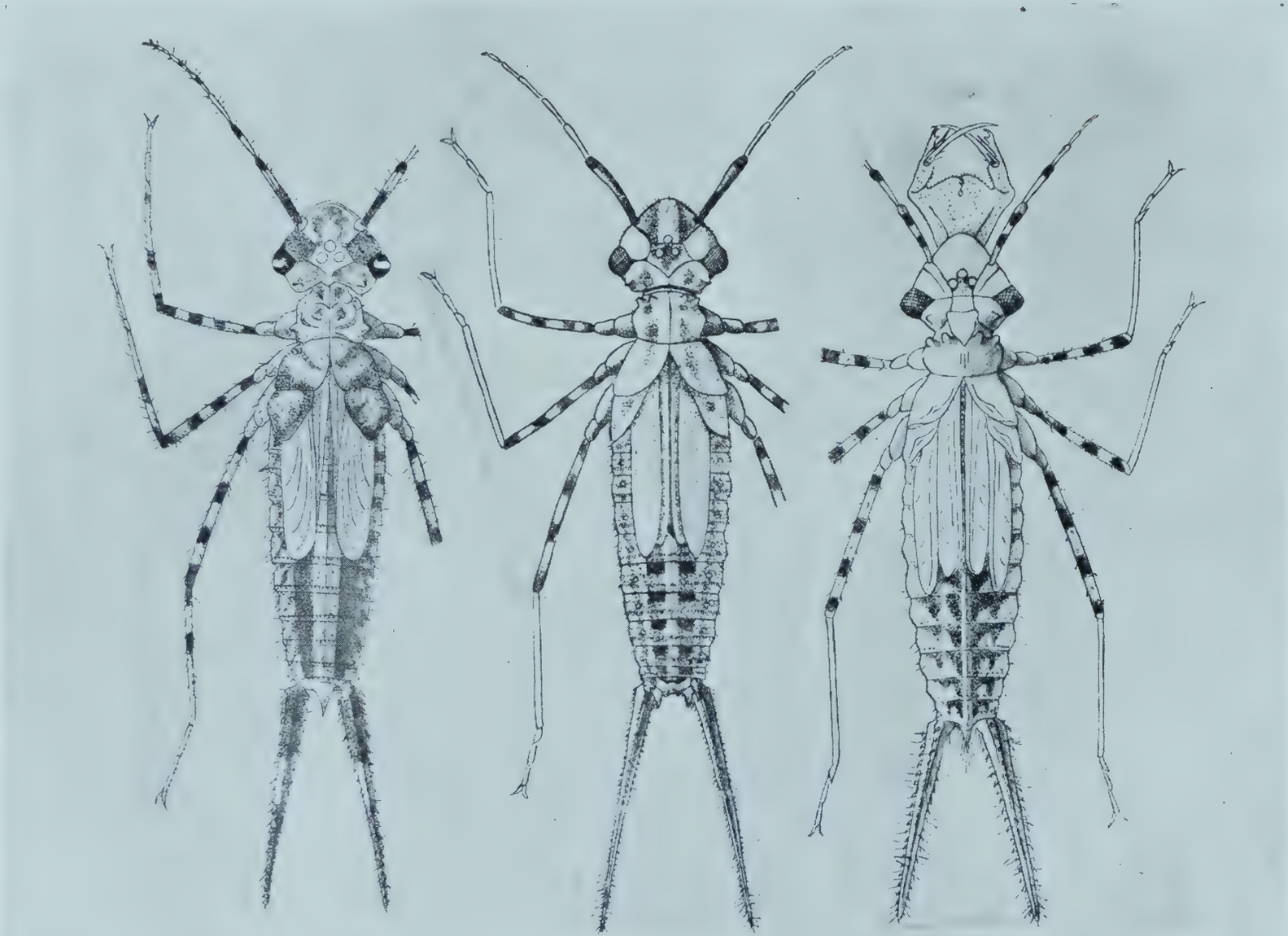
Head black spotted with citron yellow as follows:—A lateral spot on each side of epistome, which latter is metallic blue at its anterior extremity ; two pairs of squarish spots on frons, a rounded spot on the outer side of each hinder ocellus, a postocular rounded spot on each side of occiput and a linear spot on its hinder border. In very adult specimens the latter spot and the hinder pair of the frontal spot absent.

Prothorax black with a small geminate spot on the middorsum of posterior lobe and a large spot on each side of mid-lobe, yellow.

Thorax black marked with citron yellow as follows,—the middorsal carina finely, an antehumeral stripe broadening below, a fine humeral stripe incomplete below or almost obsolete, two small spots on antealar sinus, and two broad fasciæ on the sides of thorax, the anterior of which is bifid below and narrowed and sickle-shaped above.

Wings hyaline, tinted palely with amber at bases, the forewings tipped with black for about 3 mm. and without pterostigma. Costa reddish immediately proximad of node ; hindwing with well-formed pterostigma, black, covers 2 to 3 cells ; discoidal cell traversed once in all wings ; 5 antenodal nervures, 10 postnodal to all wings.

Abdomen bright orange, the articulations narrowly black, as also the ventra border of segments. Segment 2 with an irregular black apical marking, not meeting over dorsum but prolonged obliquely forwards on the sides to fuse with black of ventral border. On segments 3 to 8 a pair of minute black dorsal subapical points ; segment 9 with the latero-ventral border extending on to dorsum especially apicad where it indents the orange ground colour ; segment 10 with its sides and apical border black.



LIBELLAGINE LARVÆ

FIG. 1. Larva of *Rhinocypha ignipennis*, Selys.
,, 2. ,, *Micromerus lineatus indica*, subsp. nov.
,, 3. ,, *Rhinocypha bisignata*, Selys.

Anal appendages black, shaped as for *greeni*, twice the length of segment 10. Inferiors only half the length.

Female unknown.

Distribution. Only a single specimen of this insect has been taken within India limits, this in Mergui, Lower Burma, a male by Mr. Elton Bott, now in the Pusa Museum. It is not uncommon however in Malaysia and thence throughout Southern Asia. Williamson reports it from Trong, Lower Siam, Martin from Tonkin, Laidlaw from Borneo. The markings of the abdomen are very reduced in the Burmese example. The Siamese example has the base and sides of segment 1 black, as also a lateral black stripe on segments 3 to 8, enclosing a basal spot of the ground colour on segments 3 to 5 and incomplete basad on segments 6 to 8. There is also an interrupted black stripe on the sides of segments 2 to 8 in the type from Singapore. Type in Selysian collection.

Libellagine; Larvae.

Only three larvæ of the *Libellaginæ*, two *Rhinocypha* and one of *Micromerus*, are known. All three agree in everything except minor details so that we may say for certain that those of *Libellago* are not dissimilar.

Very sluggish in habits and cryptic in colouring, they are difficult creatures to find. They cling to roots or broken-up debris in slow-running streams or at the bottoms of pools in swifter running ones. I have found the easiest way to take them is to dredge out a quantity of such debris and spread it on the foreshore of the stream, exposed to the sun. So soon as it has drained and the creatures have begun to feel the heat of their new environment, will they begin to stir from their lethargy, and as a consequence, are at once easily detected.

They possess three spine-like caudal gills, which are undeveloped in the earlier instars. All appear to have banded limbs and most, some cryptic brown markings on the head, thorax and abdomen. The mask is deeply fissured, the edges of the fissure overlapping; the lateral lobes are cheliform and furnished with a long movable hook. The whole mask is of remarkable length, extending back, when in repose, to the hinder legs.

The gizzard has numerous folds, usually 16 in number, each bearing a row of 4 to 5 teeth. The antennæ long and 8-jointed, the basal one very short, the penultimate of great length.

Autotomy of the caudal gills is accomplished with the greatest ease so that it is difficult to obtain one with all intact; probably these are more for defence than for respiratory use, and they certainly carry on quite well without them.

For details of the respective larvæ, the reader is referred to Plate III.

(*To be continued*)

THE STUDY OF PLANT LIFE

BY

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PART I.

(With two Plates and 5 text figures)

The study of plant life, otherwise known as Botany, is very often believed to be one of those 'dry-as-dust' subjects which hold no, or little, interest for the average man and one that is best left to those cynics who find no pleasure in life; in fact, a botanist is very often considered a 'dry-as-dust gentleman.'

Just as we meet different types of people, so there are also different types of botanists for, like other subjects, Botany is divided into many different branches. First comes the Systematist who splits the Vegetable Kingdom up into classes, orders and families and ultimately into genera and species. To this type of Botanist we owe the scientific names, and without him it would be almost impossible to carry on, as classification and the fixing of the species must necessarily form the basis for other phases of botanical work. The Systematist, while he is able to give us the names, may know little of the functions and life of the plants he has examined; this is the department of the Physiologist who endeavours to explain the functions of various plants and their organs in the light of researches made by the Systematist. There are then the Specialists who have an exhaustive knowledge of a single group or genus. Their knowledge is very deep but often narrowed to the limits of their special subjects. Lastly we may refer to the all-round botanist who, although his knowledge may not go so deep as that of the Specialists, in all likelihood gets more pleasure out of the subject as a whole, and is better able to see the wonder and infinite variety of the Vegetable Kingdom and to approach its true position in the general scheme of life on our planet. He will have more ample opportunity of studying plants in their natural environment, noticing their habits, likes or dislikes and their special peculiarities which are as infinitely varied as those manifested in animal life.

The Animal Kingdom, including man with all his achievements, is almost entirely dependent on the Vegetable World for existence.

The existence of plants does not strike us so forcibly as does that of animals, perhaps on account of the absence of locomotion (though locomotion *is* present in the lower microscopic forms of plant life) and other activities similar to those of the Animal World.

From the layman's point of view, one of the drawbacks to the study of botany in India is perhaps that the majority of books available require a fore knowledge of the subject before they can be used to any advantage. It is this drawback that is mainly responsible for the fact that many in search of a hobby set aside botany as a subject without vital interest.

This and the following articles are being written with a view to awaken the interest of my readers to the ' little world ' within ours to which we are so deeply indebted, and to lay before them as far as possible, the Little Book of Nature from the reading of which so much interest and pleasure may be derived.

The Cycle of Plant Life.

What is this cycle of plant life and how may we study it? Some regard the Vegetable Kingdom as a dead domain from which we learn but little; but in reality it is a very living one from which an infinite amount of knowledge may be gathered. Each little plant has its own little story to tell of its place in nature. The whole of the Animal Kingdom is dependent on plants either directly or indirectly for its food and to a great extent for the fresh air which is so necessary for its existence. We could go on indefinitely forging the links in that wonderful chain known as the ' Economy of Life ', but this would take us beyond the scope of the present article and so only brief reference to these links will be made. In the course of our story I will endeavour to cover the cycle of plant life from the seed to the mature plant and back to the seed, and to reveal the sequence of the life history.

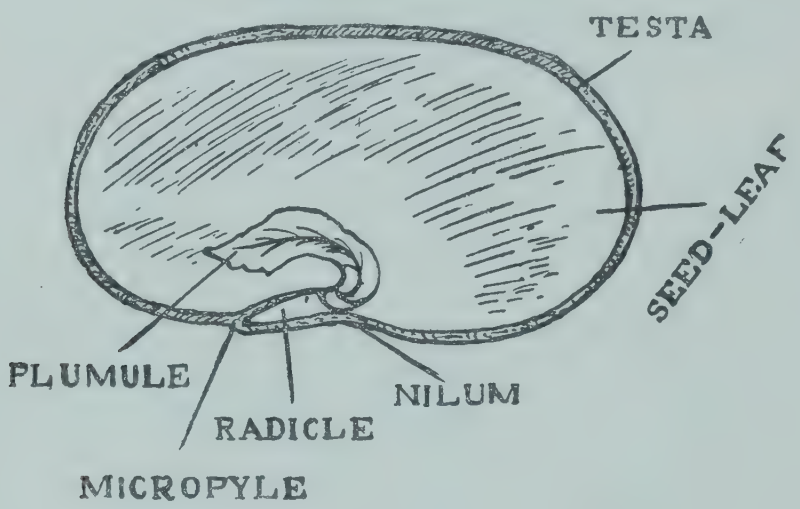
To commence this cycle and to read the wordless story which plants tell us every day of our lives, it would perhaps be best to start from the seed and follow the development of the plant which springs therefrom to the stage where the seed is returned by the plant to earth again. The unanswerable question ' Which came first the egg or the hen ' ? or in our case, ' the seed or the tree ? ' might perhaps arise in the mind of my readers, but as this question is just a matter of opinion and conjecture, I leave it to the reader to decide which he would prefer to have first. For my purpose I propose to start from the seed.

The Seed.

What is a seed? To put it bluntly, a seed is that apparently dead object which when given the requisite amount of moisture, develops and gradually begins to show signs of life—it grows! Where does the life come from? The so called seeds of plants contain the germ (life) which after varied periods of rest (for this they must have) and under favourable conditions spring into life as it were, develop into new individuals, thus carrying on the growth of the species—' pay the debt to their ancestors ' as our Hindu friends would say. The periods of rest vary, as I have said, sometimes for many years. Barley and Oats (seeds) last over ten years. Seeds containing oil lose their power of germination very soon because the oil becomes rancid; in Willows, e.g., already after a few days. Some seeds germinate in the fruit, i.e., in some Mangroves

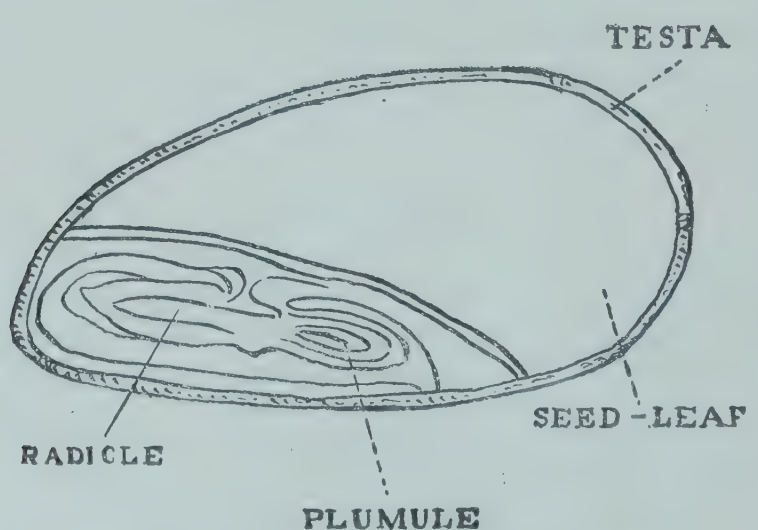
(*Rhizophora*). In the soil some seeds are preserved for one hundred and fifty years. Heldreich has shown that seeds of Silene (Campion) have retained their power of germination from 1500–2000 years.

If we examine a seed carefully either with the unaided eye or preferably with a hand lens, we shall find that it is composed of (1) an outer skin, the **testa** or *seed coat*: (2) the *seed leaf* or leaves or **cotyledons**, which compose the two halves of a seed (taking a pea seed for example); (3) the *germ* or **embryo** which is carefully



SECTION OF DICOTYLEDONOUS SEED.

packed away and protected by the seed leaves. All plants are not entirely dependent on this mode of reproduction, but it is the general one among the flowering plants. It might be mentioned here that the Vegetable Kingdom is divided into two large classes (*a*) the Flowering Plants technically known as the *Phanerogams*; (*b*) the Non-flowering plants the *Cryptogams*. The last mentioned



SECTION OF MONOCOTYLEDONOUS SEED.

contain the ferns, mosses, etc. The Flowering Plants are again divided into two, the *Dicotyledons*, those possessing two seed leaves,

such as peas, beans and most of the large trees ; this class possesses perhaps the largest number of orders ; and the *Monocotyledons*, those which have only one seed leaf, such as the Orchids, Lilies, Grasses, etc. Having seen the great divisions into which the plant world is divided, which is not altogether out of place here, we shall return to our story.

As I have said, the production of seed is the general rule but there are some which propagate their species by a process known as ' budding '. The Pine Apple, for instance, propagates its species by producing top and lateral buds which themselves develop into new plants. These buds are fostered by the parent plant till they drop off and are then able to look after themselves. There are other plants again which may be grown from parts of the leaves and cuttings, such as Begonias. The rose is a familiar example of plants derived from cuttings, as the cultivated roses rarely seed. In some plants as soon as a part of the stem or branch reaches the soil, it develops *adventitious roots* (of which we shall see more when we consider the roots of plants) and sooner or later severs all connection with the parent plant to lead an independent life. The violet is a good example of this.

Ferns have no visible ' seeds ', but their place is taken by structures known as ' spores ' which are developed in special organs known as *sporangia* on the under surface of the leaves or fronds or have specially composed organs which bear them. The spores may be easily seen if one examines the underside of the fronds, they form little brown, black or yellowish masses distributed over the underside. In some cases the masses of sporangia are arranged in definite patterns. Mosses develop little pin-head like organs, known as capsules, which contain the spores. It will suffice to say that most of the lower forms of plants bear spores and that there are various types or spore-bearing structures to be met with amongst them.

Having studied the different means of reproduction and propagation to be met with in the Vegetable Kingdom, we shall now consider the development or germination as it is called of a seed and follow up its growth step by step until we reach it again at the top of the tree. Let us suppose that our seed has reached a favourable locality and has received a sufficient supply of moisture. If we watch it closely it will be noticed that it gradually begins to swell up—the first signs of growth in cases of seeds with a thin seed coat —till it bursts. The thin testa or seed coat which has up to now enveloped the cotyledon (seed leaves) casket enclosing the embryo can no longer contain the growing embryo, so it naturally splits at a particular spot (of this spot we shall see more later on). The first evidence of the plant which is emerging from the seed is a tiny white conical structure—the first root, from which the elaborate root system will be developed in the future. It immediately begins to take a downward curve irrespective of the position of the seed before or after germination. One may prove this by a simple experiment with a few beans which have been kept in water overnight or until they germinate. Should the reader however wish to pursue the experiment further, all he need do is to get an empty cigar box

and remove one side and substitute a piece of glass sloping from the top inwards (fig. 1). Fill the box with damp saw dust and place a few of the beans in it near the top of the glass in different positions.

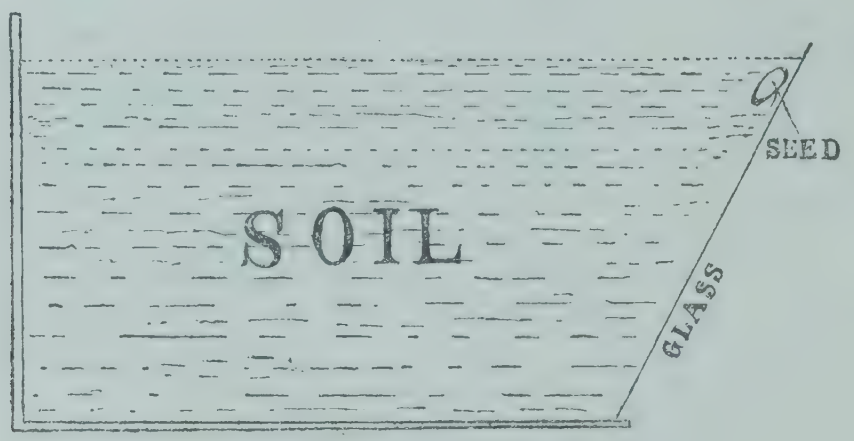


FIG. 1.

Through this glass screen the reader will be able to see the root system as it develops from the germinating seeds, to observe what are known as the root hairs (the functions of which I will explain presently) and also how the roots invariably take a directly downward direction irrespective of the position of their point of emergence from the seed. The tendency of growing vertically downwards is known as *Geotropism*, i.e., growing towards the centre of the earth.

In many instances soon after the root has appeared and attached itself to the substratum, the seed lifts itself above the surface of the soil, casts the testa and unfolds the two halves of which the seed was composed, i.e., the seed leaves or cotyledons. Between them will be seen a minute pair or more of other leaves, beautifully folded, which will develop in course of time. In some cases the seed-leaves remain thick and fleshy, while in others they expand and take the form and colour of ordinary leaves, though generally very different in shape to the leaves that follow. When they first appear above the surface of the soil they are white but as a result of the action of light they become green. The cause of this will be explained when we take up the subject of the leaves. Seed-leaves are heavily charged with reserve food for the young plant and act in the same way as the yolk of an egg. After the leaves have appeared and taken on the duties of supplying part of the necessary food, the seed-leaves shrivel up and fade away, their duties being ended. The vegetative part or shoot always grows upwards or towards the source of light. This tendency which is just the opposite to that of the root, for roots grow away from light, is known as *Heliotropism*, i.e., growing towards the light or sun. A very simple experiment will prove this :—Place a few developed seedlings in an absolutely dark box with a small hole bored somewhere low down on one side to let in light. After a day or two open the box and examine the seedlings and it will be noticed that the plants have changed their direction of growth from the upright towards the source of light. Fig. 2.

As breathing is common to all living things when in an active state (for breathing is almost at a standstill during hibernation), it might be asked, do seeds breathe? The answer is not difficult—though in the case of the seed it may not be considered as breathing in the strict sense of the word. Breathing as is generally understood is an interchange of gases, usually through organs specially adapted for the purpose. Animals give off carbon dioxide (Co_2) and inhale oxygen by day as well as by night, plants on the other hand, while they follow the same process by night, reverse it by day breathing in carbon dioxide and exhaling oxygen. Seeds give off Co_2 especially at the time of germination. There is a tiny aperture at one end of the seed, known as the micropyle through which this breathing, so to speak is carried on. It is here that the radicle or first root breaks through the testa.

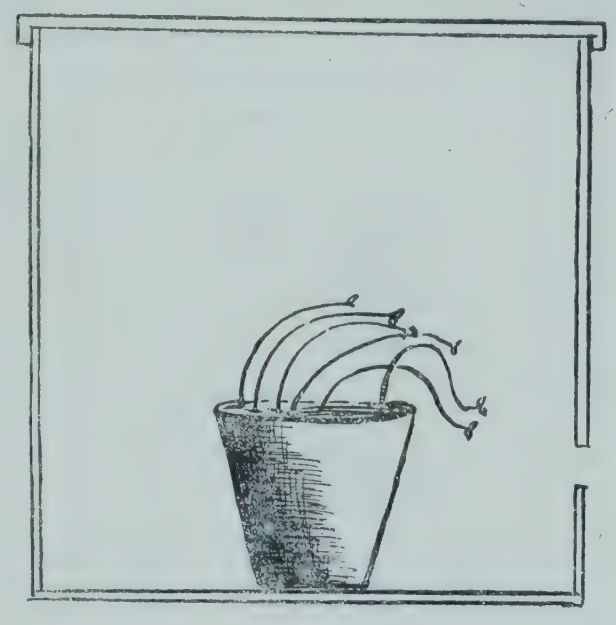


FIG. 2.

The prompt extinguishing of a lighted taper inserted into a bottle in which germinating seeds have been enclosed, indicates that the seeds have exhausted or breathed in the oxygen contained in the bottle. Similarly the heat, the oppressiveness and the tendency to suffocation on entering a closed room in which grain is stored is due to the breathing of the seed and the accumulation of gases in the room.

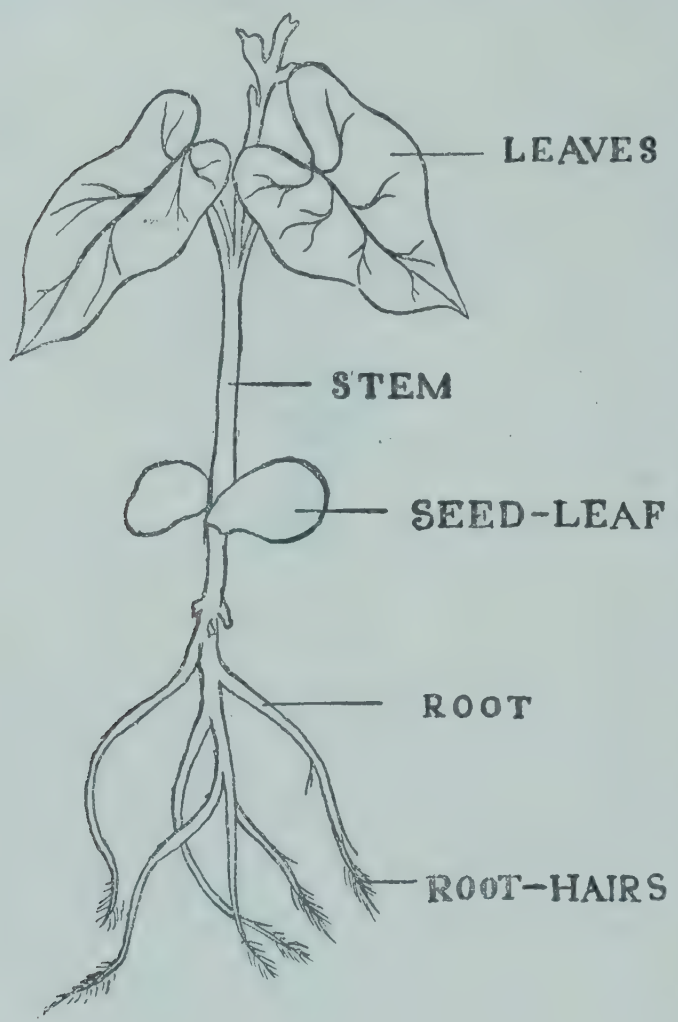
The seeds of Monocotyledons, as has been said before, possess only one seed-leaf and this does not as a rule appear above the surface of the soil but nourishes the young plant from where it lies.

Now that we have seen the chief parts of which a seed is composed, viz.: the testa, the seed-leaves and the germ or embryo, and superficially studied its development, we shall proceed to follow up its growth from the root and gradually climb up the tree till we return to it and complete the cycle. The development of the lower types of plants from the spores, we shall consider in a future article.

THE ROOT.

To go on with our story, we commence by carefully examining the first root or radicle which, as I have already indicated, shows itself first and appears as a white or creamy thread-like process which descends into the earth. On appearance it is smooth but it soon develops fine hair-like structures known as the *root-hairs*. Root-hairs do not grow all over the root, but are confined to the growing end. As the root elongates the upper hairs are lost and are replaced by new ones near the growing tip. From the radicle

the great root systems of large trees are developed. As the root branches in various directions, the growing extremities of each branch are also clothed with root-hairs. The older parts of the roots become darker in colour and thicker in proportion, assuming a corky covering to protect them. It may be asked, what are the root-hairs and what useful purpose do they serve? Root-hairs are unicellular prolongations which are very essential to the life of every plant: they are the 'procurators,' as it were, of a great quantity of the mineral food and moisture that is necessary to the plant. They go into the microscopic crevices between the particles of soil and take up the available moisture and the particular salts in solution in the soil that are necessary to their growth. They do not absorb all the mineral salts which are present in the soil, but have the power of selection. An acid secretion which exudes from the root-hairs is powerful enough to dissolve such salts as are not soluble in water and to absorb them. At the same time this acid secretion also helps the roots to push their way through hard soil and even rock by disintegrating it, though as a rule the roots follow the line of least resistance.



A SEEDLING OF A BEAN SHOWING THE PARTS OF WHICH IT IS COMPOSED.

The root tip which is the growing part is very delicate and tender and is covered by a special structure the *Root-cap* which protects the growing end on its way through the soil. The root-cap consists of layers of cells which are thickened to form this protecting cover. As the outer layers of this root-cap are destroyed, new layers are being formed on the inside. This root-cap is best displayed by the Palms and especially in the case of the roots of the Screw-pine or *Pandanus* which is fairly common along our shores, from the flower of which the Keora scent is extracted. The part of the root which is protected by the root-cap is devoid of root hairs. The region which is covered by root-hairs is known as the 'root-hair region.' As I have said before the root-hairs secrete an acid. If a piece of polished marble was placed at the bottom of a box in which some

beans were allowed to germinate in a covering layer of saw dust, it will be seen after a suitable lapse of time that the growing roots on encountering the resistance of the marble in the downward course have not only spread all over its surface but have left as a result of the acids given out by them, a distinct impression of their outline upon its polished surface.

Not the whole of the root is capable of elongation but the growing part is restricted to about $\frac{1}{10}$th of an inch from the tip. The root tip is sensitive to various stimuli and will react accordingly. Water is the chief attraction and roots may go many yards to obtain it. When water is deep below the surface of the soil, roots will go down deep but when it is near the surface they spread out near the surface. The root systems in plants vary according to the amount of moisture required and are very often governed by the position of the leaves. In some plants the leaves are so arranged that when the rain water or dew falls on them it is directed towards the stem and thence to the roots. In such cases the root system is restricted to a very small area and very often consists of only a tap root or main root. Good examples of these plants are Cannas, Lilies, etc., which require a good supply of water at their particular seasons. In others the branches are spread out and the moisture falls to the ground from the tips of the leaves; the moisture is thus spread over a greater area. Naturally the root system of these plants is in proportion to the crown. Most of the large trees are good examples of this type of root system.

We have examined the root hairs and root cap; let us now have a glance at the older portions of the root which were left behind by the growing ends and have had time to enlarge. These parts have long since lost their root hairs and thus no longer have the power of absorption. Nevertheless they still continue to grow but not in length. At first they become discoloured and put on an outer layer of protective armour—cork—which is secreted by the outer cells and which gradually becomes thicker in order to protect the internal 'channels' which convey the sap[1] from the root hairs through the stem to the leaves. They also increase in girth and become more and more rigid to be able to support the tree. What purpose do roots serve? Besides being the ducts through which the soluble food and moisture is passed on to the stem and leaves they serve the purpose of anchorage—of keeping the tree upright and preventing it from being blown down by winds and storms to which it will be subject in the future. These are the two main functions of the root, but they are not all. They are also used as 'store-houses' for surplus food and moisture which is accumulated during a favourable season and enables the plant to endure through the long periods of draught or to serve it through its periods of rest—that is to say that they come up during one season, flower, fruit and accumulate reserve material and then die down again to the surface, of the ground only to reappear next season. Accordingly plants are classified into different groups. Plants which develop very rapidly during a favourable season from seed and die down completely after producing seed are known as

[1] The word 'sap' is used here in its generally accepted meaning.

Annuals—living but one season. Plants whose life is prolonged beyond a single year or over an indefinite number of years are called Perennials. We know now that roots perform the chief functions, (1) of procurators of food, (2) of anchorage, (3) of store-houses and reservoirs. A brief survey of different types of roots to be met with and the varied shapes they assume according to the requirements of a particular species, will not be out of place here.

Among plants belonging to the Dicotyledons, the radicle or tap root grows and gives off branches and these branch again in turn; with the Monocotyledons, on the other hand, the radicle is short-lived. Roots that appear from other parts of the plant and are known as adventitious roots. These are slender and thread like and are spoken of as *fibrous* roots.

We find this type of root most common among all the Monocotyledons, such as Grasses, Lilies, etc. Adventitious roots are also to be met with among the Dicotyledons of which the Banyan (*Ficus bengalensis*) and others are good instances.

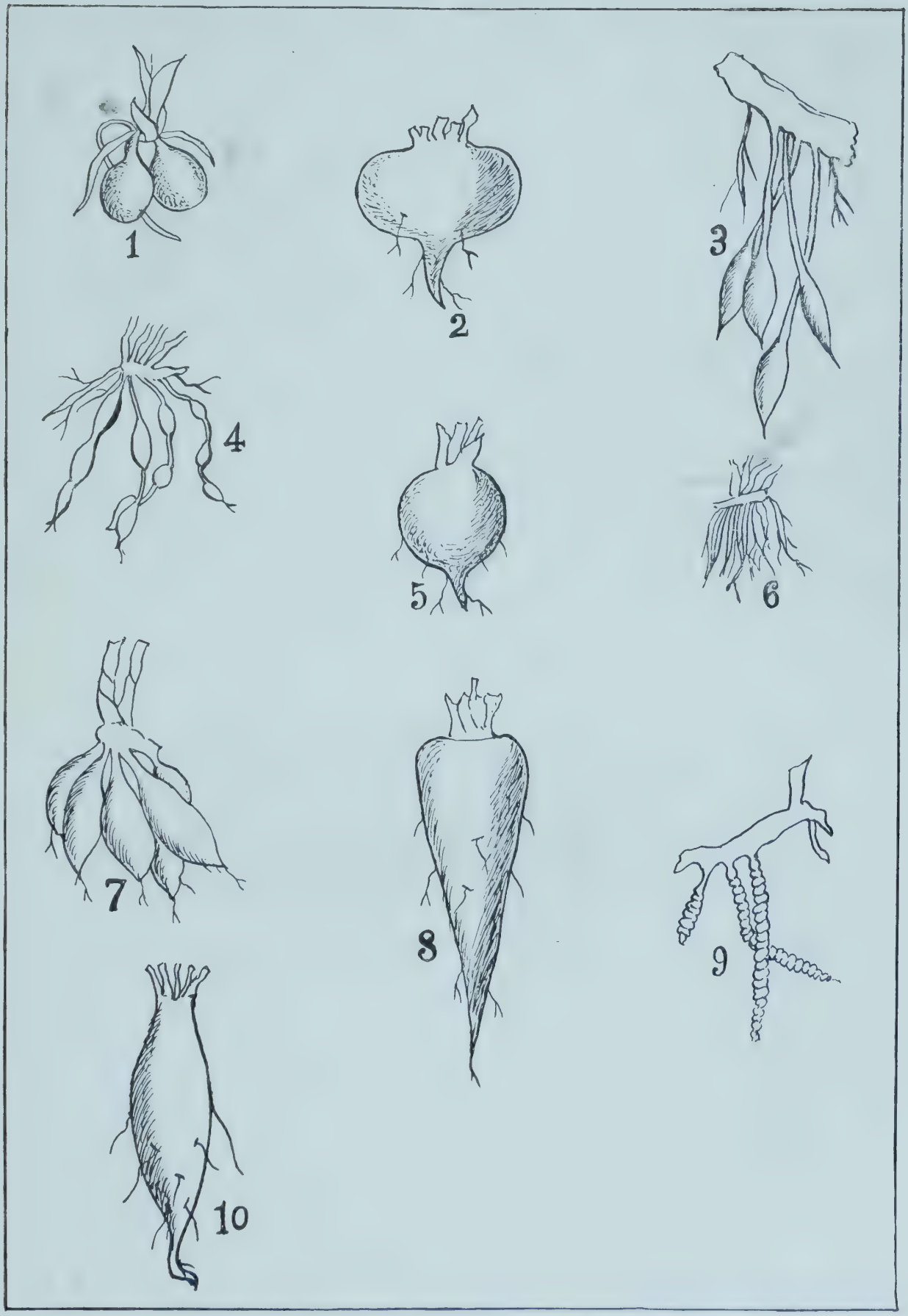
As we have seen, roots may act as a store-house and in consequence assume enormous proportions and various shapes. Thus we have roots whose names are descriptive of their shape. The Carrot is a good example of a *conical* root serving the purpose of storage, the Beet assumes a *spindle shape*, while the Raddish is either *conical* or *globular*. Dahlias have swollen or *tuberous* roots. These are a few examples among many which might be indicated here. All these queer shapes originate from fibrous roots. Care must be exercised however not to confound tuberous roots with a *tuber*, for example the common potato, which is a fleshy underground stem and not a root at all.

An iodine test will show that such roots contain a high percentage of starch, as iodine stains starch a bluish-purple. Beet contains cane-sugar, while the roots of the Dahlia contain inulin. The value of these roots to the Animal Kingdom and man in particular is readily apparent.

As a protection against the depredations of field-mice, insect larvæ and other underground animals, many food-storing roots develop poisonous and nasty substances in their tissues, in the way of noxious alkaloids, foetid gum, resins and other products well known to druggists; it has been observed that such roots are very seldom attacked.

Frequently plants produce more than one type of root, serving different purposes, some being fibrous, absorbing roots, others swollen and charged with reserve food. Some roots after greatly elongating, contract and pull the stem lower down into the soil, such as the Lilies and other familiar plants which have no apparent stem but grow with their leaves in rosettes adpressed to the ground.

Roots often go to a very great depth into the soil, much deeper than people imagine, especially in hard and dry subsoil, in the quest for water. Even in rich garden soil the roots of wheat have been traced to a perpendicular depth of five or six feet. This is however trifling when compared with the depth to which the tap-root of a Baobab-tree (*Adansonia digitata*) descends. Anderson in his account



DIFFERENT TYPES OF ROOTS

1. Testicular root.
2. Napiform root.
3. Nodulose root.
4. Moniliform root.
5. Globular root.
6. Fibrous roots.
7. Tuberous facicular root.
8. Thickened Tap-root.
9. Annulated roots.
10. Fusiform root.



Aërial Adventitious Roots of the Banyan (*Ficus bengalensis*).



Another type of Adventitious Root. The 'Screw Pine' (*Pandanus Sp.*)

of Senegal, records the root of one of these trees to have reached a depth of one hundred and ten feet.

Then there are what are known as *aerial* roots. These are exemplified by most of the *epiphytic* orchids, i.e., growing on trees but not obtaining their nourishment from them. There are other plants which have aerial roots such as the Banyan, already referred to and also the Pandanus, but these answer mainly the purpose of support.

The roots of many orchids are *feeding* aerial roots. They are modified for absorption of nutriment from the surrounding atmosphere ; in some cases the orchids have no leaves, the roots obtaining for the plant all that is requisite for its nourishment and support. The roots hang downwards like white-threads or cords, the whiteness being due to a papery membrane which covers the green chlorophyll-containing cells of the true root. The envelope consists of perforated cells and acts like a sponge. When they come into contact with water they absorb it immediately until they fill out. The inner living green cells are thus surrounded by a fluid envelope and are able to obtain from it as much moisture as they need. Besides, this sponge tissue has the power of condensing aqueous vapours and other gases, so that the plant is entirely independent of its host for nourishment. Trees growing in marshy ground also send up aerial roots in order to obtain oxygen which is absent in the water-logged soil. Familiar examples of these roots are to be met with in the different species of mangroves which are so common along the marshy shores of the Islands of Bombay and Salsette.

Some large trees develop large root-expansions as additional supports and these are known as *buttress* roots. These roots stand out like great wings round the base of the tree and their development is so enormous at times that a man standing between two of these buttresses would be effectively screened.

The roots of some aquatic plants dangle in the water from which they derive their nourishment, while others contain large air-spaces which aid the plant to float.

Roots possess one almost constant character and that is, that they produce members like themselves, i.e. root-branches, while the stems produce dissimilar members—leaves. However, it frequently occurs that roots give rise to leafy shoots—at times a boon to gardeners and at others a curse, especially in the case of weeds. It often happens that the seemingly complete eradication of weeds in a garden is followed after a few days by fresh outcrops and the area that was apparently cleared is covered with weeds again much to the disgust of the gardener. The reason for this is that part of the roots were left behind in the soil and having the power to send up shoots have covered the ground once more. These shoots are known as *adventitious shoots* or *suckers*.

There still remains one type of root, i.e., the roots of parasitic plants. These plants are entirely dependent on their host for their nourishment and send their roots into the food-canals of the branches or roots of their host and suck them dry. A good example of this is the *Loranthus*, a near relative of the Mistletoe *(Viscum album)* which is commonly to be seen in great clusters on mango trees

and others. This plant supplies us with an extremely interesting example of the motility of young roots. The fruit contains birdlime—a peculiar viscous, tenacious and elastic substance—and when the berry falls away it adheres to whatever it falls upon. The seed is embedded in the viscid pulp and germinates commencing in the following way. 'The radicle,' says Mr. N. E. Brown, 'at first grows out, and when it has grown to about an inch in length, it develops upon its extremity a flattened disc; the radicle then curves about until the disc is applied to any object that is near at hand. If the spot to which the disc has fastened is suitable, the germination continues and no locomotion takes place; but if the spot should not be a favourable one, the germinating embryo has the power of changing its position. This is accomplished by the adhesive radicle raising the seed and advancing it to another spot, or to make the purpose plainer, the disc at the end of the radicle adheres very tightly to whatever it is applied to; the radicle itself straightens and tears away the viscid berry from whatever it has adhered to and raises it in the air. The radicle then again curves and the berry is carried by it to another spot, where it adheres again. This disc then releases itself, and by the curving about of the radicle is advanced to another spot, where it again fixes itself. This, Dr. Watt says, has been repeated several times, so that to a certain extent the young embryo, still within the seed, moves about. It seems to select certain places in preference to others, particularly leaves. The berries on falling are almost certain to alight upon leaves, and although many germinate there: they have been observed to move from the leaves to the stem, and finally fasten there. (Gardener's *Chronicle*, 1881).

It might have been better perhaps if we had considered the *sap* of plants at an earlier stage, but before we leave the roots we must elaborate a little more on their functions as procurators of part of the food of plants. *Sap* is the fluid which the roots absorb from the soil or the leaves from the air and which contains in solution the true nutritive principles. Water is the main substance of the sap. It has been estimated that for every two hundred grains of water absorbed and exhaled by a plant only one grain of inorganic matter has been taken up and for every 2000 grains of water consumed one grain of inorganic substance has been appropriated. Young and growing parts of plants are well supplied with sap which fills up every available space in the plant-tissues which is not already occupied by other substances. It is conveyed into the plant by the root hairs, and does not undergo any marked change till it reaches the leaves. Sap may be acid or sweet, clear or turbid, nutritious or otherwise so that its value from an economic point of view is considerable. The acid taste of most unripe fruit is due to the sap. Citric acid, the most common form is found in the juice of lemons, oranges and many of the commonest fruits, and it often exists together with other acids, such as malic acid in the gooseberry, currant and several others. The latter acid is found alone in apples and pears. It is due to the action of these acids that knives are stained when used on various fruit. It is perhaps due to the presence of these acids that young fruit are protected from the attacks of birds and animals which feed

on the ripe fruit which is one of the factors in seed dispersal. Birds and animals which eat the ripe fruit containing the fully developed seeds often pass them out in their excreta sometimes miles from the place where they were eaten. The seeds are usually undigested and thus help nature in the dispersal of seed and the propagation of the species in other localities.

In some cases the acid juices of plants destroy or deaden one's sense of taste if masticated, and this state may often last for hours according to the quantity eaten. In some cases sugar tastes like sand in the mouth after taking some of these plant acids by chewing the leaves, flowers or seeds. A sweet orange under the same conditions will taste sour ; the citric acid alone remains distinguishable ; sweet and bitter tastes being destroyed. After a good dose of the leaf of a tropical Asclepiad known as *Gymnema sylvestre*, quinine tastes like chalk.

The sweetness of the sap of the Beet-root is due to the presence of *canose* or cane-sugar dissolved in it. It was first discovered by a Prussian chemist named Margraff (about 1747), but it was not till 1809 when Napoleon forbade the importation of cane-sugar into France from the West Indies, that the discovery was turned to practical account. An Imperial sugar factory was then established at Rambouillet ; pupils were instructed in the process, premiums were offered for the best samples of the sweetener, and in the course of a few years the manufacture of beet-sugar was prosperously set on foot.

Cane-sugar is abundantly found in sugar-cane and the sugar-maple. It is also found in the nectaries or honey-secreting glands of flowers where it furnishes the substance from which the bees gather their honey.

It is secreted by the nectaries and the quantity is at its fullest during the emission of the pollen but stops soon after fertilization of the flower.

A careful distinction must be made between cane-sugar and grape-sugar or *glucose*. These are differently produced by the plant and when treated with the reagent known as Fehling's solution react differently—glucose gives a bulky yellow deposit which canose does not.

Besides these juices there are the milky ones exuded by many plants especially the milkworts (Euphorbias). These milky juices are known as latex. Strange though it may seem, this milky juice is clear while in the uninjured tissues but instantly becomes turbid on exposure to the air. The colour of latex is generally white, but yellow, red and in rare cases blue milk-saps are met with. The microscope shows that it consists of a colourless fluid in which float myriads of minute globules which give the sap its opaque appearance. The common Euphorbia (often erroneously called Cactus) frequently used as a hedging, is a good example of this type of plant. India rubber which is obtained from a tropical American tree (*Hevea brasiliensis*) and other trees, and opium from the opium Poppy (*Papaver somniferum*) are dried juices of such plants.

(To be continued.)

NOTES AND DESCRIPTIONS OF FISHES FROM CEYLON

BY

HENRY W. FOWLER

OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

(*With 2 Plates*)

The collection reported below was purchased by the Academy of Natural Sciences of Philadelphia in 1924 fron Dr. F. Hallberg, of Göteborg, Sweden. All were obtained at Colombo. Several of the species are of special interest and one appears to be new to science.

ENGRAULIDÆ

Engraulis commersonii (Lacépède)

Depth $4\frac{4}{5}$; head 4, width $2\frac{1}{5}$. Snout $4\frac{1}{2}$ in head; eye $3\frac{3}{4}$, covered with adipose membrane, greater than snout or interorbital; maxillary reaches gill opening, $1\frac{1}{8}$ in head; row of fine teeth on each maxillary and narrow bands on vomer and palatines; interorbital 4, slightly convex. Gill rakers 19 + 21, lanceolate, greater than gill filaments or $1\frac{1}{5}$ in eye. Scales very caducous, mostly fallen, 33 (pockets) in lateral series from shoulder to caudal base, 9 transversely, 21 ? predorsal: vertical striæ 7; pectoral axillary scale $\frac{2}{3}$ of fin, ventral scale $\frac{7}{8}$; no abdominal scutes; venulose area at shoulder moderate. Dorsal III, II, I inserted little nearer caudal base than front eye edge, third simple ray $1\frac{3}{5}$ in head; Anal III, 17, I, inserted opposite last $\frac{2}{5}$ in length of depressed dorsal, first branched ray $1\frac{9}{10}$; caudal $3\frac{3}{4}$ in combined head and body, forked; least depth of caudal peduncle half its length or $2\frac{1}{5}$ in head; pectoral $1\frac{1}{2}$; ventral 2. Largely pale brown. Faint silvery lateral band, less than eye in width, widest on caudal peduncle. Iris pale slate. Dorsal and caudal gray, other fins whitish.

One 110 mm.

TACHYSURIDÆ

Hemipimelodus dussumieri (Valenciennes)

Depth $5\frac{1}{3}$; head 4, width $1\frac{1}{6}$. Snout $3\frac{1}{5}$ in head; eye 4, $1\frac{1}{5}$ in snout, $1\frac{4}{5}$ in interorbital; mouth width $2\frac{1}{10}$ in head; band of villiform teeth in each jaw, palate and tongue edentulous; maxillary barbel reaches $\frac{3}{5}$ in pectoral spine, outer mental $\frac{1}{4}$ in pectoral spine, inner mental barbel not quite to pectoral spine; internasal space slightly less than interorbital, nostrils large, front one close to edge of snout and posterior about midway in snout as seen in profile; interorbital $2\frac{3}{4}$ in head, slightly convex; occipital fontanel broad, reaches to base of occipital bony plate, which about over gill opening; occipital buckler with median ridge, wide as long, long as snout. Gill opening with slight median notch, free from isthmus. Dorsal I, 6, spine adipose like for greater portion terminally, equals head; adipose fin large, slightly over half of head length; Anal v, II, first branched ray $1\frac{3}{4}$; caudal I, forked; least depth of caudal peduncle $2\frac{1}{5}$ in its length or $3\frac{1}{5}$ in head; pectoral $1\frac{1}{5}$, spine slightly over half length of fin; ventral $1\frac{4}{5}$. Back and head above pale gray brown, below whitish. Snout, occipital fontanel and under surface of head whitish. Iris leaden gray. Barbels dusky, pale basally. Fins all pale or whitish, upper front edge of spinous dorsal or dorsal spine dusky. Caudal with gray terminally.

One 47 mm. Evidently the young of this species, which changes considerably in proportions with age.

HEMIRAMPHIDÆ

Hemiramphus neglectus Bleeker

Depth $8\frac{1}{2}$ from upper jaw tip, body subcylindrical; head $4\frac{2}{5}$, width 3. Snout 2 in rest of head, free portion little broader than long, width in snout to eye $1\frac{1}{3}$; eye 3 in head from snout tip, $1\frac{1}{8}$ in snout, slightly greater than interorbital; mouth cleft $\frac{2}{5}$ to eye, lower jaw before snout tip 4 to caudal base; maxillary $\frac{4}{5}$ to eye, vertical expansion slightly less than pupil, length $3\frac{3}{4}$ in head from upper jaw tip; interorbital $3\frac{1}{2}$, slightly depressed; postorbital $\frac{3}{4}$ of eye. Gill rakers $9 + 19$, lanceolate, equal gill filaments or 3 in eye. Scales 47 from above gill opening to caudal base and 3 ? more on latter, predorsal 40 ?; all little adherent, most having fallen; basal radiating striæ 3, circuli moderately small. Dorsal I, 13, first branched ray $2\frac{1}{4}$ in head from snout tip; Anal I, 13, first branched ray 3; caudal I, moderately forked or emarginate, lower lobe longer; least depth of caudal peduncle $1\frac{1}{4}$ its length or $4\frac{1}{4}$ in head; pectoral $1\frac{1}{3}$; ventral $2\frac{1}{2}$, inserted little nearer head than caudal base. Faded pale brownish, largely uniform. Predorsal with 3 median close set parallel dusky lines. Narrow dusky band from over gill opening to caudal base, nearly wide as pupil on tail aboveanal, its lower edge with darker bordering line. Snout above and occiput with close set dusky to blackish dots. Beak blackish-brown, continued back along each side of mandible as blackish brown streak nearly to eye. Iris slaty. Fins all pale. Dorsal and anal tinted with gray brown.

One 135 mm. Also one for comparison from Padang, Sumatra, 136 mm. It differs in Depth $8\frac{1}{3}$; head $4\frac{1}{2}$; snout $2\frac{2}{3}$; eye $3\frac{9}{10}$; interorbital 4; gill rakers $6 + 11$; Dorsal II, 13; Anal II, 15.

Certainly very close to *Hemiramphus unifasciatus* (Ranzani) from the Tropical Atlantic. Comparison with examples of this latter from Porto Rico shows the American form with a shorter preorbital, which also a little wider than long.

Zenarchopterus dispar (Valenciennes)

Depth $7\frac{1}{2}$ from upper jaw tip, body slightly compressed; head $3\frac{7}{8}$, width $2\frac{4}{5}$. Snout $1\frac{9}{10}$ in rest of head, free upper portion broader than long, width in snout to eye $1\frac{2}{3}$; eye 4 in head from snout tip, $1\frac{1}{2}$ in snout, $1\frac{1}{6}$ in interorbital; mouth cleft $\frac{3}{5}$ to eye, lower jaw before snout tip $2\frac{1}{2}$ to caudal base; maxillary largely concealed, $\frac{4}{5}$ to eye, nearly vertical, expansion $\frac{3}{4}$ of pupil, length 3 in head from snout tip; interorbital 3, level. Gill rakers $6 + 12$, lanceolate, long as gill filaments or $3\frac{3}{4}$ in eye. Scales 42 in lateral series from above gill opening to caudal base and 3 more on latter, 4 above lateral line, 2 below, 38 predorsal; few basal scales at front of anal; 5 or 6 basal radiating striæ marginally and circuli fine. Dorsal 12, first ray $3\frac{1}{5}$ in head from upper jaw tip; anal I, 8, first branched ray $2\frac{1}{3}$; caudal $1\frac{1}{6}$, truncate; least depth of caudal peduncle $1\frac{2}{3}$ in its length or 4 in head from snout tip; pectoral $1\frac{2}{5}$; ventral $3\frac{2}{5}$. Back brown, with median dusky line on predorsal. Underlaid gray brown line from shoulder to caudal, greatest width about $\frac{3}{5}$ of pupil along side of tail. Beak blackish. Snout dusky. Iris slate. Vertical fins grayish, more or less dusky terminally. Paired fins pale.

One 150 mm.

Cypselurus hallbergi, new species

(*Plate I*)

Depth $5\frac{1}{4}$; head $4\frac{1}{3}$, width $1\frac{3}{5}$. Snout $3\frac{1}{2}$ in head from snout tip; eye $3\frac{1}{2}$, with free lids, $1\frac{1}{5}$ in interorbital; maxillary concealed, $\frac{4}{5}$ to eye, equals snout; teeth minute, sparse, form slight band in each jaw, none on palate or tongue; interorbital $2\frac{1}{3}$ in head, very slightly concave. Gill rakers $7 + 21$, lanceolate, equals gill filaments or $1\frac{7}{8}$ in eye. Scales slightly adherent, rather well exposed; 47 between gill opening above and caudal base and 3 more on latter; 8 above lateral line, 3 below to anal origin; predorsal 30, extending forward little before nostril; 5 or 6 basal radiating striæ, edge lobate and circuli finely concentric. Lateral line not reaching caudal or not extending beyond tip of last anal ray; tubes slender, simple. Dorsal I, II, I, first ray $2\frac{1}{4}$ in total head length; Anal I, 9, I, first branched ray $3\frac{1}{8}$, fin inserted opposite base of second branched dorsal ray; caudal widely forked, upper lobe $1\frac{1}{3}$ in that of lower which $3\frac{1}{4}$ in combined head and body; least depth of

caudal peduncle $1\frac{2}{5}$ or 3 in head ; pectoral not quite reaching caudal base, $1\frac{1}{2}$ in combined head and body, rays iv, 13 ; ventral **I, 5**, spine nearly third of fin which reaches back far as pectoral (right fin shorter), length $2\frac{4}{5}$ in combined head and body, its insertion midway between hind eye edge and caudal base. Back deep brown, lower sides and under surface whitish. Iris slate. Lower jaw pale. Dorsal and caudal pale brown. Anal whitish. Pectoral neutral brown medially, terminally dusky, pale basally and lower basal margin whitish. Ventral neutral brown medially and terminally, with broad inner whitish border, base and spine also pale.

One example, the type, 195 mm. (lower caudal tip damaged so estimated at 207 mm.). Differs from all the species of the genus I have examined in the increased rudimentary or simple rays in the pectoral and also in the increased gill rakers. Apparently resembles *Cypselurus simus* (Valenciennes), but unlike any I have seen in the above respects. It is also suggestive or *Cypselurus oxycephalus* (Bleeker), but that species falls within the subgenus *Exonautes* as the anal origin is opposite that of the dorsal.

I take pleasure in dedicating this species to Dr. F. Hallberg who collected the type.

Anabantidæ

Anabas testudineus (Bloch)

One 70 mm. Small dark spot on opercular flap, less than pupil. Caudal base with small vertical brown bar.

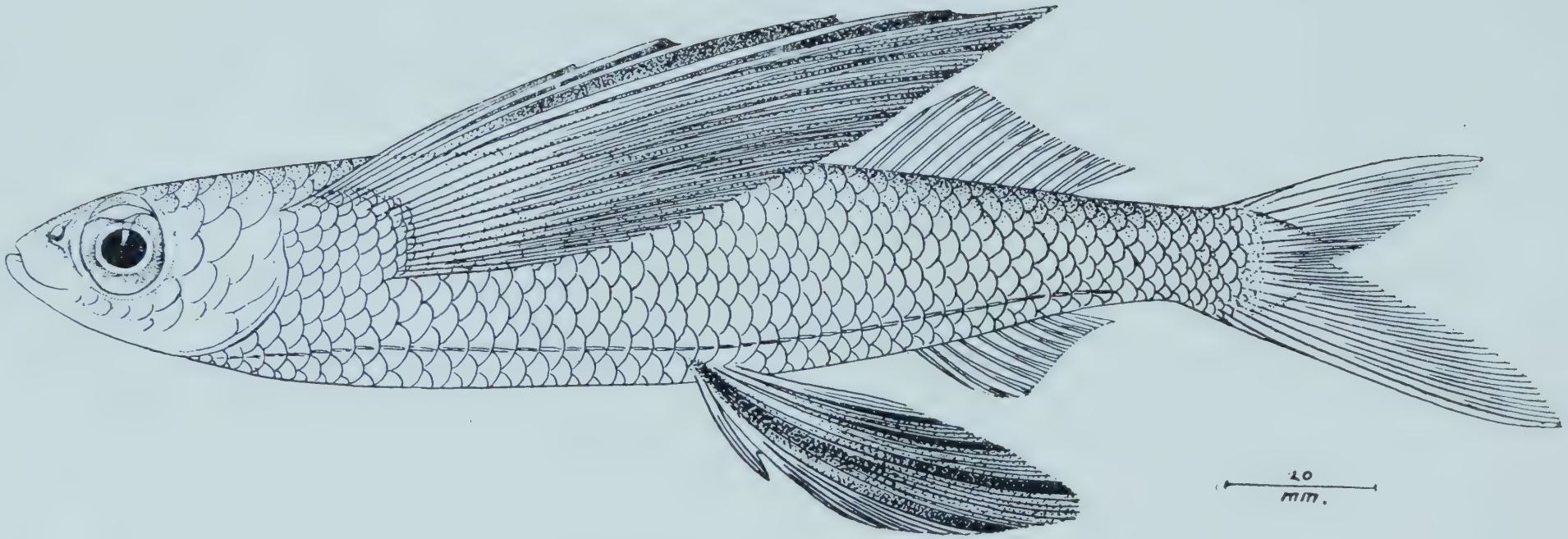
Atherinidæ

Atherina duodecimalis, Valenciennes

(*Plate II*)

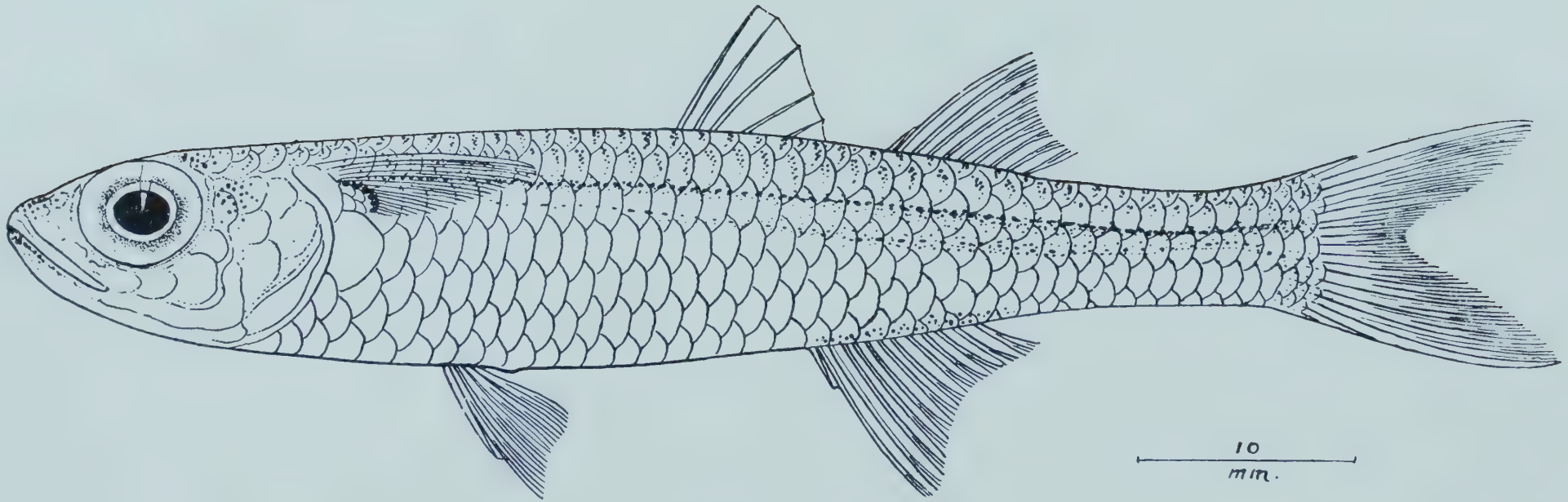
Depth $5\frac{2}{5}$; head $3\frac{3}{4}$, width $1\frac{3}{4}$. Snout $3\frac{4}{5}$ in head from snout tip ; eye $2\frac{1}{2}$, greater than snout or interorbital ; maxillary reaches first fifth in eye, $2\frac{2}{3}$ in head ; teeth small, conic, in bands in jaws, on vomer and palatines ; mandibular rami moderately elevated inside mouth ; interorbital broadly concave, $2\frac{1}{2}$ in head. Gill rakers 5 + 21, lanceolate, slender, $2\frac{2}{3}$ in eye. Scales 38 from above gill opening to caudal base and 4 more on latter, 7 transversely, 16 predorsal, 5 behind depressed spinous dorsal ; single row of scales on cheek ; large scale below pectoral base nearly large as eye ; scales with 3 basal marginal points and 30 basal, vertical, parallel striæ, apical region smooth and with 18 small inconspicuous marginal lobes. Dorsal **V—I**, 10, 1, second spine $2\frac{1}{3}$ in total head length, first branched ray $1\frac{3}{5}$ and spine of soft fin short or $\frac{1}{3}$ of first ray ; spinous dorsal origin midway between eye center and caudal base ; anal base about equals its distance from caudal ; Anal **I**, 12, first branched ray $1\frac{3}{5}$ and spine $\frac{1}{4}$ its length ; caudal equals head, well forked, lower lobe little longer ; least depth of caudal peduncle $3\frac{1}{8}$; pectoral $1\frac{1}{6}$; ventral $1\frac{3}{4}$. Uniformly pale brownish, with more or less whitish or silvery. Top of head, end of mandible and snout dusted with dusky brown. Patch of dusky dots on middle of opercle. Each scale of back above with submarginal arc of dusky brown dots. Narrow band of dusky dots along scales at base of anal. Gray band from pectoral axil to caudal base medially, little less in width than pupil at greatest expansion which opposite soft dorsal and anal. Fins all pale, with arc of dusky dots at pectoral base.

One 70 mm. Interest attaches to this specimen as the species was originally described from Ceylon and that it does not appear to have been obtained there since. The type is very briefly described with Dorsal **V—I**, 9 and Anal **I**, 12, its length 76 mm. Bleeker's materials, as given by Weber and Beaufort are apparently the same. It is not a *Hepsetia*, however, as catalogued by Jordan and Hubbs. No previous writer has yet described it completely and as it has not been figured the accompanying drawing is offered. The large infrapectoral scale, the position of the vent at the first $\frac{2}{5}$ of the ventral fins and black in color, will serve to distinguish it from allied species as *Atherina forskali*, Rüppell and *Atherina lacunosa*, Schneider. Ogilby has indicated a large infrapectoral scale for the last named.



Cypselurus hallbergi, New Species.

Henry W. Fowler del.



Atherina duodecimalis, Valenciennes.

Henry W. Fowler del.

MUGILIDÆ

Mugil longimanus, Günther

Depth $3\frac{2}{5}$; head $3\frac{2}{3}$, width $1\frac{3}{4}$. Snout 4; eye $3\frac{3}{5}$, greater than snout, $1\frac{3}{4}$ in interorbital; maxillary concealed, reaches eye, $3\frac{2}{3}$ in head; mandibular angle forms broadly obtuse; lower preorbital edge finely serrate. Scales 31 from above gill opening to caudal base, 12 transversely at soft dorsal, 25 predorsal, 5 behind depressed spinous dorsal; soft dorsal and anal covered with fine scales; axillary pectoral scale $\frac{1}{3}$ of fin; scales with 6 or 7 basal radiating striæ, no apical points. Dorsal VI—I, 8, 1, first spine $1\frac{3}{4}$ in head, first branched ray $1\frac{4}{5}$; Anal III, 9, 1, first branched ray $1\frac{3}{5}$ with third spine $\frac{3}{5}$ its length; caudal I, deeply emarginate; caudal peduncle depth $2\frac{1}{5}$; pectoral $1\frac{1}{10}$, reaches little beyond dorsal origin; ventral $1\frac{2}{3}$. Gray brown above, silvery white below. Dorsals, caudal and pectorals with gray brown, last with small diffuse dusky spot at origin. Hind caudal edge dusky. Lower fins whitish. Iris slaty.

One 91 mm.

CARANGIDÆ

Caranx ignobilis (Forskal)

Depth $2\frac{2}{5}$; head $2\frac{9}{10}$, width $2\frac{1}{6}$. Snout $3\frac{2}{5}$ in head from snout tip; eye $3\frac{1}{10}$, with narrow adipose lid behind, subequal with snout or interorbital; maxillary reaches eye center, length $2\frac{1}{6}$ in head; interorbital 4, convex. Gill rakers 6 + 15, lanceolate. Scales 43 + 31, arch $1\frac{2}{5}$ in straight section of lateral line, 14 above, 22 below, scute depth $1\frac{4}{5}$ in eye; breast naked below to ventral, except small patch of small scales posteromedially. Dorsal I, VIII, I, 19, 1, third spine $2\frac{2}{5}$ in total head length, first branched ray $2\frac{1}{10}$; Anal II—I, 16, 1, second spine $1\frac{1}{2}$ in eye, first branched ray $2\frac{1}{10}$ in head; caudal $1\frac{1}{3}$, strongly forked; least depth of caudal peduncle $1\frac{4}{5}$; pectoral $1\frac{1}{10}$, reaches fourth scute of lateral line; ventral $2\frac{3}{5}$. Back brownish, below silvery white. Iris slate. Spinous dorsal dusted dusky. Soft dorsal and caudal with pale brownish, other fins whitish.

One 94 mm.

Caranx sexfasciatus. (Quoy and Gaimard)

Depth $2\frac{1}{2}$; head 3, width $2\frac{1}{6}$. Snout $3\frac{1}{3}$ in head from snout tip; eye 4, adipose lid covers last sixth of eye, subequal with snout or interorbital; maxillary reaches opposite eye center, expansion $1\frac{3}{4}$ in eye, length $2\frac{1}{10}$ in head; row of short conic teeth in each jaw and narrow inner band with same, also narrow bands of very small teeth on vomer and palatines and tongue; interorbital 4, convexly elevated; preopercle flange with radiating and marginal venules. Gill rakers 7+15, lanceolate. Scales 43+31, arch $1\frac{2}{5}$ in straight section of lateral line; scute depth $1\frac{7}{8}$ in eye; breast densely scaled. Dorsal I, VIII, I, 20, 1, fourth spine $2\frac{1}{3}$ in total head length, first branched ray $1\frac{9}{10}$; Anal II—I, 16, 1, second spine $5\frac{1}{5}$, first branched ray $2\frac{1}{10}$; caudal $1\frac{1}{5}$, strongly forked; least depth of caudal peduncle $6\frac{7}{8}$; pectoral $1\frac{1}{10}$, reaches fourth scute of lateral line; ventral $2\frac{1}{3}$. Back brown, below whitish. Back and sides with 6 or 7 broad obscure darker vertical bands, broader than interspaces. Iris slate. End of mandible brownish. Spinous dorsal neutral dusky. Soft dorsal and caudal with pale dusky marginally, otherwise pale or whitish like other fins.

One 105 mm.

LEIOGNATHIDÆ

Leiognathus splendens (Cuvier)

Three 41 to 51 mm. These agree with Day's figure, though as they are young the back is with large diffuse dull brown blotches. Black blotch including 3 highest membranes of spinous dorsal terminally greatly contrasted. All show a neutral dusky basal line along dorsals. Lower half of body sprinkled with dusky or blackish dots. Iris slate.

CHEILODIPTERIDÆ

Amia endeketænia (Bleeker)

Depth 3; head 3, width $2\frac{1}{2}$. Snout 4 in head from snout tip; eye $3\frac{1}{5}$, greater than snout or interorbital; maxillary reaches opposite eye center, expansion $2\frac{1}{4}$ in eye, length $2\frac{1}{5}$ in head; bands of minute teeth in jaws, on vomer and palatines; interorbital $4\frac{4}{5}$ in head, nearly level; preopercle ridge entire, edge finely serrate. Gill rakers 5 + 15, lanceolate, $2\frac{1}{4}$ in eye. Scales 21 in lateral line to caudal base and 2 more on latter, 2 above, 6 below, 6 predorsal to occiput, 2 rows on cheek; 10 to 13 basal radiating striæ, apical denticles 30 to 32, weak, small, in 3 transverse series and circuli moderate, Dorsal **VI — I, 9**, second spine $1\frac{4}{5}$ in total head length, first ray $1\frac{1}{3}$ with spine of soft dorsal $1\frac{3}{4}$ in first ray; Anal **II, 8**, second spine $2\frac{7}{8}$, first ray $1\frac{2}{3}$; caudal $1\frac{1}{6}$, forked; least depth of caudal peduncle $2\frac{3}{5}$; pectoral $1\frac{3}{5}$; ventral $1\frac{7}{8}$. Faded pale brown generally. Traces of 4 dusky longitudinal narrow bands; second begins on side of snout, crosses eye and postocular, where most distinct. Iris slate. Back and head above with dull brown shades. Fins all more or less pale. Spinous dorsal dusky terminally. Soft dorsal and anal each with diffuse dusky subbasal longitudinal band. Round blackish spot little smaller than pupil at caudal base medianly. Caudal margined above and below with pale dusky.

One 54 mm. It differs a little from Day's figure in that he shows the second dorsal spine but half length of third, whereas in mine the second and third spines are subequal.

AMBASSIDÆ

Ambassis safgha (Forskal)

Depth $2\frac{1}{3}$; head $2\frac{1}{2}$, width $2\frac{4}{5}$. Snout $4\frac{2}{5}$ in head from snout tip; eye 3, greater than snout or interorbital; maxillary reaches opposite front pupil edge, expansion 3 in eye, length $2\frac{1}{2}$ in head: interorbital 5, very slightly convex; preorbital edge entire, lower edge with 7 serræ; lower ridge and edge of preopercle serrate. Gill rakers 9 + 17, lanceolate, slender, $1\frac{4}{5}$ in eye. Scales 30 in incomplete lateral line to caudal base and 3 more on latter, 4 above, 7 below, 22 predorsal, 3 rows on cheek; 1 to 3 basal radiating striæ, no apical denticles and circuli moderate. Dorsal **VII, I, 9, 1**, second spine $1\frac{1}{3}$ in total head length, first ray $2\frac{1}{4}$; Anal **III, 9, 1**, third spine $2\frac{1}{8}$, first ray $1\frac{1}{10}$; caudal $1\frac{1}{10}$, deeply forked, lobes slender and pointed; least depth of caudal peduncle $3\frac{1}{2}$; pectoral $1\frac{1}{5}$; ventral $1\frac{3}{4}$. Uniform pale brown, scales along edge of predorsal and about back posteriorly above with deeper brown dustings. Mandible and upper jaw brownish. Iris slate. Lateral gray line along tail and caudal peduncle medially faint. End of second membrane of spinous dorsal dusky, fins otherwise all pale.

One 88 mm.

Ambassis gymnocephalus (Lacépède)

Depth $2\frac{4}{5}$; head $2\frac{3}{4}$, width $2\frac{2}{5}$. Snout 4 in head from snout tip; eye $3\frac{1}{2}$, greater than snout or interorbital; maxillary reaches first fourth of eye, expansion $3\frac{2}{5}$ in eye, length $2\frac{3}{4}$ in head; interorbital $4\frac{1}{2}$, very slightly convex; preorbital ridge and edge, also lower ridge and edge of preopercle serrate. Gill rakers 8 + 21, lanceolate, slender, $1\frac{3}{5}$ in eye. Scales 11 + 10 in interrupted lateral line to caudal base and 2 more on latter, break below front of soft dorsal. 3 scales above, 6 below, 17 predorsal, 2 rows on cheek; 5 basal radiating striæ, no apical denticles and circuli moderate. Dorsal **VII, I, 9, 1**, second spine $1\frac{2}{5}$ in total head length, second and third spines subequal, first ray 2; Anal **III, 9, 1**, third spine $1\frac{4}{5}$, first ray $1\frac{7}{8}$; caudal I, deeply forked, lobes slender; least depth of caudal peduncle $2\frac{1}{2}$; pectoral $1\frac{1}{3}$; ventral $1\frac{3}{5}$. Uniform pale brownish, scales along edge of back dusted with deeper brown, also jaws dusted brown. Distinct dusky slate line along caudal peduncle and tail medianly each side. Second dorsal membrane blackish. Fine pale. Iris slate.

One 60 mm. *Ambassis urotænia*, described from Delagoa Bay by Fowler[1] is not Bleeker's species, but a younger stage of the present, as it is described with 2 rows of scales on the cheek.

[1] *Proc. Acad. Nat. Sci. Phila.*, 1925, p. 220.

LUTJANIDÆ

Lutjanus kasmira (Forskal)

Depth $2\frac{3}{5}$; head $2\frac{2}{5}$, width $2\frac{1}{6}$. Snout $3\frac{1}{5}$; eye $3\frac{4}{5}$, $1\frac{1}{10}$ in snout, greater than interorbital; maxillary reaches $\frac{1}{3}$ in eye, expansion $2\frac{1}{5}$ in eye, length $2\frac{1}{3}$ in head; interorbital $4\frac{2}{5}$, little convex; preopercle edge not gashed behind, finely denticulated and denticles larger around angle. Gill rakers $7 + 15$, lanceolate. Scales 43 in lateral line to caudal base and 7 more on latter, 7 above, 12 below, 16 predorsal, 5 rows on cheek; 7 or 8 basal radiating striæ, apical denticles 40 to 58, with 6 or 7 series of transverse basal elements and circuli fine. Dorsal X, 13, 1, fourth spine $2\frac{2}{5}$ in head, first ray $2\frac{3}{5}$; Anal III, 8, 1, second spine $2\frac{3}{4}$, second ray $2\frac{1}{8}$; caudal $1\frac{1}{4}$, slightly emarginate; least depth of caudal peduncle $3\frac{1}{10}$; pectoral $1\frac{2}{5}$; ventral $1\frac{4}{5}$. Back brown, sides below and under surface paler to whitish. Each row of scales with obscure pale median stripe. Diffuse dusky stripe from snout tip through eye across postorbital. Diffuse blackish blotch size of eye on lateral line below front of soft dorsal. Vertical fins pale brownish, paired fins paler or whitish. Iris slate.

One 84 mm.

THERAPONIDÆ

Therapon jarbua (Forskal)

One 100 mm.

SPARIDÆ

Sparus berda Forskal

One 80 mm. Molars in 3 rather irregular series in each jaw posteriorly. Preorbital with its least width $1\frac{3}{5}$ in eye. Dark blotch at shoulder but little distinct. Dorsal with more or less dusky on membranes terminally.

LETHRINIDÆ

Lethrinus reticulatus, Valenciennes

Depth $2\frac{3}{5}$ to $2\frac{7}{8}$; head $2\frac{2}{3}$ to $2\frac{3}{4}$, width $2\frac{1}{4}$ to $2\frac{2}{5}$. Snout $2\frac{7}{8}$; eye 3, $1\frac{1}{8}$ in snout, greater than interorbital; maxillary not quite or to eye front, 3 in head; interorbital 4 to $4\frac{1}{8}$, slightly convex. Gill rakers $4 + 7$, short tubercles. Scales 45 in lateral line to caudal base and 2 more on latter, 6 above, 13 below, 9 predorsal. Dorsal X, 9, 1, fourth spine $2\frac{2}{5}$ to $2\frac{4}{5}$ in head, first ray $2\frac{2}{5}$ to $2\frac{1}{2}$; Anal III, 8, second spine $2\frac{1}{3}$ to $2\frac{4}{5}$, second ray $2\frac{2}{5}$; caudal $1\frac{1}{5}$ to $1\frac{1}{3}$, emarginate; least depth of caudal peduncle 3 to $3\frac{1}{10}$; pectoral $1\frac{1}{8}$ to $1\frac{1}{6}$; ventral $1\frac{1}{2}$. Pale olive gray, slightly paler on under surface. Sides and back with darker and rather large reticulations, mostly with meshes deeper vertically. Iris slate. Postocular more or less dark olive. Variably diffuse dark blotch above pectoral base and another vertically at caudal base. Dorsals and caudal with grayish tints, fins otherwise pale.

Two 68 to 72 mm. These appear to be the young of this species, originally described from an example 102 mm. long obtained in New Guinea. Valenciennes says the head is reddish with 2 or 3 brown bands below the eye. Opercular border yellow. Body paler than head, irregularly blotched with blackish. Soft dorsal, anal and caudal finely streaked with dusky. Bleeker's figure[1] appears to be the same, though it is less variegated than my examples, or without the dark suprapectoral blotch or the basal caudal bar. *Lethrinus mœnsii* Bleeker also appears to be the adult stage. The species ranges from the Seychelles to Oceania.

GERRIDÆ

Gerres lucidus Cuvier

One 70 mm. Snout short, $1\frac{2}{3}$ in large eye, which $2\frac{1}{2}$ in head. Third dorsal spine $1\frac{2}{3}$ in head, second spine but little shorter Though spinous dorsal dusky terminally on 3 highest membranes the usual spots subbasal on membranes above edge of basal scaly sheath are little evident.

SILLAGINIDÆ

Sillago sihama (Forskal)

One 140 mm.

[1] *Atlas Ichth.*, 8, 1877–78, Pl. 330 (52), Fig. 1.

MONODACTYLIDÆ

Monodactylus argenteus (Linnæus)

One 64 mm. Brown ocular band and narrower brown band from before spinous dorsal down on opercle.

SIGANIDÆ

Siganus javus (Linnæus)

One 62 mm.

Siganus virgatus (Valenciennes)

One 85 mm. This differs largely from Day's figure in that the dark ocular band from the spinous dorsal to the chin is very obsolete, though it has traces of several dark interorbital lines. The head and body are rather coarsely spotted, blotched or vermiculated with deeper brown. Spinous dorsal and anal clouded with deeper brown, though on soft dorsal 3 rows of dusky spots largely on each ray and most distinct basally on fin. On anal largely as 2 dark basal bars. Caudal transversely and diffusely barred with dusky. Pectoral pale. Ventral dusted with dusky.

GOBIIDÆ

Glossogobius biocellatus (Valenciennes.)

Depth $5\frac{1}{5}$; head $2\frac{7}{8}$, width 2. Snout $3\frac{3}{4}$ in head from snout tip ; eye $4\frac{7}{8}$, $1\frac{1}{2}$ in snout ; maxillary reaches nearly opposite hind eye edge, 2 in head ; teeth moderately large, well spaced, in bands in jaws, none on palate ; tongue with deep median notch in front ; interorbital narrow bony frenum, $2\frac{1}{2}$ in eye. Gill rakers 2 + 7, short low rounded tubercles. Scales 30 from over gill opening to caudal base and 3 more on latter ; 8 scales transversely from soft dorsal origin ; 14 predorsal ; 14 to 17 basal radiating striæ, apical denticles 31 + 41 to 32 + 36 and circuli fine. Dorsal VI—I, 9, 1, fourth spine $2\frac{1}{3}$ in total head length, eighth ray $1\frac{1}{2}$; Anal I, 8, seventh ray $1\frac{1}{2}$; caudal $1\frac{1}{6}$, pointed ; least depth of caudal peduncle $3\frac{7}{8}$; pectoral $1\frac{1}{3}$; ventral $1\frac{1}{3}$. Brown above, under surface paler though more or less soiled ; back and sides mottled and marbled with dusky. Iris slate. Spinous dorsal gray, clouded with dusky, leaving some small white spots and rather large conspicuous black blotch on penultimate membrane medially. Soft dorsal gray with dusky reticulations. Caudal pale above lower portions gray with rather broad blackish transverse bars. Anal blackish, with scattered small spot basally. Pectoral with scattered dusky and blackish dots. Ventral neutral dusky termiually, outer borders pale or gray.

One 93 mm.

THE MAMMALS AND BIRDS OF KASHMIR AND THE ADJACENT HILL PROVINCES

Being

Natural History Notes

by

Col. A. E. Ward

Part VII

(*Continued from page 11 of Vol. XXXI*)

Family—*Hyænidæ*

Genus—Hyæna

This group is in India represented by

The Striped Hyæna—*Hyæna striata*

Vernacular names.—'*Lakha-bagh*, or *bagha Lakra*'—and most commonly '*Chirak* and *Jhirak*'.

Colour.—Darkish grey, sometimes of a brownish hue, traversed with tawny stripes, these are often of a blackish-brown colour, and are on the body and limbs.

Dimensions.—Head and body about 3½ feet, tail with hair under 1½ feet. Skull of a large male 8″ basal length, zygomatic measurements 6·1″. Weight 63 lbs. This specimen was shot near the Jumna bridge at Kalsi in the Western Dun.

It is not often that a hyæna can be weighed as the carcase is left as a rule when shot.

Distribution.—Very rare in Kashmir but has been found on the Murree road and in Hammel. It is fairly common in some of the hill districts with which we are concerned, and practically throughout India.

Habits.—It is not uncommon to turn hyænas out of short grass whilst beating with elephants in the Terai; on more than one occasion I have shot hyænas within a few feet of the elephant's trunk, killing dead with a charge of large shot. A big hyæna was very troublesome in a cattle-breeding farm. I camped in the farm and spent two days looking for the animal and eventually got close to it. It was eating the body of a calf within a few yards of the sheds, and to my intense surprise I killed it dead with a charge of No. 5.

Whilst staying with a regiment in a Musketry Camp in the hills, there was a good deal of trouble with the very disagreeable cries of hyænas at night. We used to turn out with guns, but although we saw the animals we were unable to shoot owing to the tents being so

close together. They occupied any small and convenient patch of ground nearby inspite of the fact that in camp were several dogs which the men used to loose after barking deer or jackals.

We were sitting in the mess tent after our meal, when we heard the men urging on their dogs. The sides of the tents were up and we were just turning out to see what was afoot, when a hyæna rushed under the table and bolted out at the other side! Beyond a chair being broken no harm was done. The hyæna ran down a ravine followed by the dogs, but apparently they did not care to face it.

Dogs, unless very wary, are apt to be greatly mutilated by hyænas; with their powerful jaws they can crush the leg of any dog.

Hyænas can be ridden down on a fast pony which is handy at turning.

The fossils in the Siwalik Hills and elsewhere in the vicinity point to there having been other species of the Hyænidæ in India, and it is believed that *H. crœata* was amongst these. Besides these above, fossils have been found in Madras. In certain parts of the submontane districts, a class of hyænas exists which are small, and are far less striped than those of the lower Punjab hills—these are only a local variety of *striata*, the only species now found in India.

Order—*CYNOIDEA.*

Family—*Canidæ*: Dogs, Wolves, Jackals, Foxes.

The differences in the footprint of a dog and a cat consist in the two central toe pads in the former being in advance of the side pads, making the footprint longer, and in the presence always of blunt nail prints, owing to the claws being non-retractile. The dentition consists amongst other teeth of four upper and lower premolars respectively whilst the cat has three premolars in the upper jaw and two in the lower jaw.

The genera are known as *Canis*, *Cyon* and *Vulpes*.

Canis includes the wolves, *Cyon* the wild dogs, *Vulpes* the foxes.

The Wolf—*Canis lupus*

Vernacular names.—*Ratnakin* in Kashmir—*Chanku* in Tibetan—*Baglura* in many jungles, where this name is given to both the Panther and Wolf.

Colour.—Wolf skins are not as variable in colouration as is generally supposed to be the case. Nearly all Tibetan wolves are grey or greyish-white with slaty under fur; some show a brownish tinge mixed with white hairs. The tail is tipped with black. A few wolves are black due to melanism. Brownish-black wolves of the colour sometimes shown by a wild cat as far as I know are rarely seen.

I have seen a black and a grey wolf with the same mother. Doubtless as was the case with the wolves which have been brought home to England, black cubs have been born from a black parent.

Alsatian hounds have been bred with wolves; the cubs are apt to fight amongst themselves, but are quite tame and affectionate to their owners. These cross-bred hounds are often difficult to rear,

they are great feeders, and are very delicate during the first year of their lives in India.

Distribution.—The species *C. laniger* is from Tibet and Ladak; the pelts sold in Srinagar are those of this class.

Habits.—Wolves are by no means nocturnal although they rest during the heat of the day. I have seen a she-wolf stand for hours in the scorching sun of Ladak, with her cubs secreted in the hills behind her, she was doing sentry-go between her offspring and the intruders.

Wolves carry portions of their prey to their caves; I doubt the wolf being much of a carrion feeder for the simple reason that they hunt in small packs and eat all the flesh of the animals they have killed, and leave the bones to be picked by carrion-eating birds. I cannot say much regarding the habits of *Canis lupus*; they are rarely seen except when travelling.

Dimensions of a very large Tibetan wolf: Head and Body 3′ 10″, height 2′ 5″, weight 60 lbs. Blanford gives a large skull as 8·7″, basal length and 5·5″ in zygomatic breadth. I tried in vain to shoot wolves in the hills between the Saseer Pass and the Shyok but could never get near them. Three wolves stood on a bare hill and watched; directly I moved they were off and when I followed them over a low hill, they watched me from the slopes of the main hill, and as soon as I showed myself, although I was lying prone on the ground, they galloped away. This occurred on the southern slopes of the Karakoram where probably the wolves had rarely seen a man.

The Indian Wolf.—*Canis pallipes*

Vernacular names—*Bheriya*, *Bagyar* and *Landga*.

Probably the best known name is *Bheriya* whilst *Langda* is the name in Gondwana.

Colour.—Grey with a very decided brownish hue; dark on the back —much browner than is *C. lupus*.

Dimensions.—Much smaller than *C. lupus* rarely exceeding 3 feet apud Blanford skull has 6·85″ basal length, and 4·4″ broad—weight from 40 to 45 lbs.

Distribution.—The plains of India, not ascending high into the Himalayas; at one time common in Abbottabad and Hazara, rare in the Punjab ranges, very rare in the Vale of Kashmir.

Habits.—Gregarious to a limited extent, possibly they would be more so, were they not continually being hunted down. Government is always on the watch to destroy wolves as they are very destructive and kill horses. cattle, sheep, goats or any live domestic animals they come across. Antelopes are systematically hunted by three or more wolves working in unison, whilst wolves which take to killing women and children are much to be dreaded.

The largest wolves I have seen dwelt in the open ground in front of the old Fort at Fatehgarh.

The Jackal.—*Canis aureus*

In vernacular—*Gidar*, *Shial* are probably the commonest names —*Shal* in Kashmir—*Hokol* in Gondwana—*Ihigal* according to

Blanford in Persia but this name is often used by Mahomedans. There are many names besides these. In parts of the C.P. '*Chota-Bagh*' is often the name.

Near Rewah territory I was taken on an elephant for miles, in order to shoot a *Chota-Bagh*, which I naturally thought was a young tiger or a leopard. On arriving at a small village I knew that I had been sold; I was taken to a thorn bush and there was the 'Jack'. This was in May! However the information was correct; the headman said the *Bagh* eat their 'murghis'. I could not help laughing, much to the disgust of the mahout.

Colour.—Pale rufuous—sometimes reddish. Albinos are very rare. Blanford mentions 'coal black'—often brown hairs on the back tipped with black.

Dimensions.—Jackals are often very large in Kashmir, where they are very destructive to sheep.

Head and body of a large jackal 31″—weight up to 25 lbs. a fine female weighed 19 lbs.—a male weighed 22 lbs.—both were killed in the winter.

Distribution.—Throughout India, ascending the hills to about 5,000′ or more. A few days ago jackals were calling at 7,500′ and I have known them to ascend to much higher elevations.

Jackals eat certain fruits notably *Zizyphus* (ber) also Indian corn. The vernacular name *Phial* is usually applied to the Jackal when frightened. The name *Phiaow* is also used, it is a mistake to think that these terms only apply to a 'Jack' which is frightened by a tiger or leopard as they will *Phiaow* even when pigs or bears or wild dogs are on the move.

Genus—*Cyon*

The Indian Wild Dog—*Cyon dukhunensis*

The only Vernacular names I know are *Ram-Hun* (Kashmiri) and *Jungli Kutta—Ban Kutta—Bhansa*. *Bhansa* in the Eastern Himalayas.

Colour.—Red. I cannot call to mind ever seeing rufuous grey or light brownish-grey (Blanford), but I have seen brownish-red wild dogs; there are sometimes dark tips to the hairs on the back. Lighter red below. The pups are sooty brown.

Dimensions.—Head and body 38″, tail with hair 14″—weight 28 lbs.—heaviest known weight 32 lbs.

The habitat extends throughout India in forest land, ranging high up in the Himalayas. In parts of the upper Indus Valley it is fairly common, but is gradually being reduced in numbers. The wild dog is very rare in the Vale of Kashmir, I have not seen one for many years past, nor have I seen the skins in the shops except one or two from Baltistan.

Habits.—Gregarious and predatory, living on any animal killed. They hunt in packs and take Sambhar, Nilgai and all sorts of deer, while cattle, sheep, goats and ponies fall, easy victims to their rapacity. Even leopards are persecuted by wild dogs and compelled to take to trees for safety. They are often heard whilst

hunting at night and over and over again have I listened to them whilst lying awake in the jungles.

That wild dogs call when hunting is true as I have watched them at a few yards whilst doing so. When running by scent they only whimper, but when the prey is in sight and at hand, they often break into an undescribable howl.

Cyon dukhunensis breed in colonies in burrows in soft ground, also in caves or holes amongst rocks, hunting the surrounding jungles. Having once found a colony, it is as well to set to work deliberately and smoke them all out. The young are probably smothered; those able to run about get into the surrounding grass and can be beaten out by a line of elephants. They are hard to hit with a bullet whilst dodging through the grass, and unless close, are still more difficult to kill with shot.

A colony was breeding within about a mile of a jungle where there were tigers. Strangely enough no foot prints of the dogs were to be seen in the vicinity and it was evident that they gave the big cats a wide berth and both refrained from interfering with each other.

The breeding season is in the winter months as a rule, but I have seen quite small pups in May.

The period of gestation is probably nine weeks.

The Indian Fox—*Vulpes bengalensis*

Vernacular names: *Lomri—Lom* in Hindustani, *Lomri* and sometimes *Lhal* in Jammu, *Kokri* and *Khakri* are names which are sometimes heard in Northern India; I have heard the name *Kokri* in the Punjab.

Colour.—From light to reddish-grey. Jerdon remarks, 'The fur just after it has assumed its winter coat is very beautiful, a pure grey in the body contrasting with the rufous limbs.'

I have often watched various foxes during the morning and evening hours and invariably remarked that early in the morning *Vulpes bengalensis* does not seem to be in the least hurry when moving off to the burrows. It is seldom that it is to be seen carrying food, homewards, but when so doing it proceeds very warily.

Dimensions.—Vary a good deal. Length, head and body 19 to 22″ generally about 22″; tail 12″ weight of a full-grown specimen 6 to 7 lbs.

Distribution.—According to Jerdon 'found throughout India' rare in forest countries. Blanford and others put the limit at 'not recorded west of Sind and the Punjab.' Personally the extreme west I have seen it is in the Jammu Province, Sialkote and adjacent localities.

The Common Fox—*Vulpes alopex*

Vernacular names: *Lomri. Laash* is not the Kashmiri name for the common fox, it is the name usually for any kind of cat. It is quite impossible to give any standard of *colour* to the Himalayan variety; go to any furriers shop and you will find pelts of almost any colouring. On the other hand *V. flavescens* is a superb fox of almost a universal yellow, often with a tinge of golden-rufous. The

weight given by Jerdon as 14 lbs. is fairly correct, but 18 lbs. has been recorded. The average weight of six male foxes is 12 lbs. The price of a pelt is about Rs. 25.

Turning to the Himalayan form. The colouring on the back varies from red and yellow, to dark grey and very rarely to black. The sides are pale. Ears are jet black outside. This portion of the skin is stitched together and made into collarets, fetching of course very high prices. The ears inside are generally buff. 'The face is rufuous, there is a large black spot in front of the eye and the cheeks are white' (Blanford). Tail nearly always grey; the tip of the tail is white.

Habits.—These foxes dwell in burrows or amongst rocks at an elevation of 5,000′ to about 8,000′. In the summer the cubs come out in the afternoon and play about on the swards of green turf; the vixen generally rests half hidden by some bushes and at the slightest sign of danger she utters a shrill bark repeating it at short intervals, finally if any of the cubs are too keen at their play, the mother races across the grass, the whole family following and they are soon lost to view. Probably none of them will be seen for some days. I have never seen the mother and cubs dart into their homes when frightened. Cubs will often play at the entrance of a cleft in rocks whilst the mother lies secreted under cover. Seldom more than five are produced at a birth and by August they are sufficiently well grown to be able to escape from most terriers.

The Small Tibetan Fox—*Vulpes ferrilatus*

Vernacular Names: *Igar* (Tibetan) according to Blanford. I have heard that name in Little Tibet. *Lokri* is the common name.

Dimensions: Head and body 19″ to 20″; tail with hair 12″.

Habitat.—Tibet, with a considerable distribution from the Northern Sutlej to the East.

Colour.—Reddish-yellow, tail plain grey, tip of the tail pure white, breast and stomach pure white.

The pelts of this fox are not common in the furriers shops, but from time to time a certain number can be selected which are so much of one size, and approximately of the same colour, as to justify the placing them as belonging to a race of foxes which come from the same locality. The traders who bring down skins give but little help. I think *V. ferrilatus* comes from nearer to our borders than do other varieties of *V. alopex*.

(*To be continued.*)

FORAGING TERMITES

(*EUTERMES BIFORMIS*, WASM)

BY

R. W. G. HINGSTON, MAJOR, I.M.S.

(*With a plate*)

The place of investigation is Central India, the district of the Bundelkhand gneiss. Here we stand on the primitive floor of the Peninsula, those crystalline rocks on which have been deposited all the later sedimentary beds. It is a tract of undulating uplands, wide flat spaces, rocky ridges, crumbling granite hills. Vast areas of it are bare, stony and neglected; other tracts are clothed profusely in forest or thorny scrub.

Eutermes biformis, a species of White Ant, is particularly partial to this kind of soil. In places I find it in great abundance, colonies under almost every stone. Here we have a species of peculiar interest. It raises no mounds, builds no elaborate nor conspicuous city, possesses none of that architectural capacity so commonly met with amongst the white ants. As an artificer it has not the slightest merit. Its interest lies in its absence of seclusion. The mound-building termites hide beneath the soil. When they move about they always do so beneath tunnels. Rarely, if ever, do they come into view. All their work takes place in the strictest seclusion, which makes them particularly difficult to observe. We must disturb them before seeing them at work. It is otherwise with *Eutermes biformis*. This venturesome species has open-air habits, excavating, foraging, guarding the termitarium in the full light of day. From it we will learn some facts about termites which otherwise we would never know.

As in all the species, we find workers and soldiers. The workers are pale yellow, with shining heads that show not a trace of eyes. The soldiers are of two distinct sizes, small ones that scarcely exceed one-tenth of an inch, and large ones that are almost one-fifth of an inch long. In one point they differ remarkably from the workers. Their mouth parts are very peculiar. They have no trace of jaws or any type of biting organ; in their place is a conical pointed spear, a kind of tubular beak. Obviously their work is altogether different from that which falls to the worker class. In addition the community has its males and females, very much larger than the workers, and provided with eyes and wings.

THE NEST

Nothing special marks the *Eutermes* nest, no mound, no heap, no citadel of spires. All it does is to make a superficial excavation scarcely more than a few inches in depth. It seldom goes down

beyond a foot. If the insect has any preference in the matter, it likes to establish itself underneath a stone.

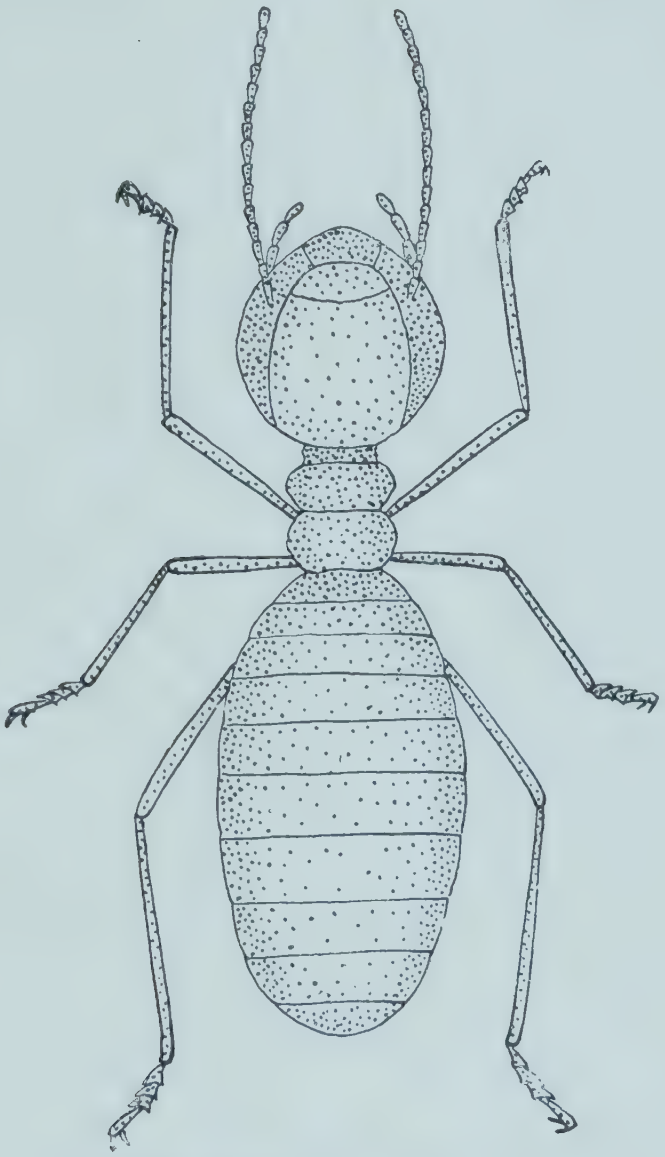
The nest consists of a ramification of passages, a reticulated system of galleries and chambers, their width being equal to about that of a lead pencil. They appear to have no particular arrangement, but just ramify and communicate in all directions. The patch of ground is literally honeycombed with the network. When exploring it we seem to be cutting into a sponge. The walls of the passages are a little roughened and usually lined with a black material. This pigment, at first sight, looks like some fungus; but more probably it is the excreta of the termites which they smear over the walls.

The galleries are always perfectly clean. What do we find in them? First of all, nurseries. Special chambers appear to be reserved for this purpose. In them we find young of all ages and sizes heaped together in a scrambling mass. Hundreds may be kept in the largest of the nurseries. Others are met with scattered through the galleries. Less often we come across sexual forms, perhaps only a few inches beneath the soil. The only other stuff I have recorded from these galleries are fragments of half-chewed grass.

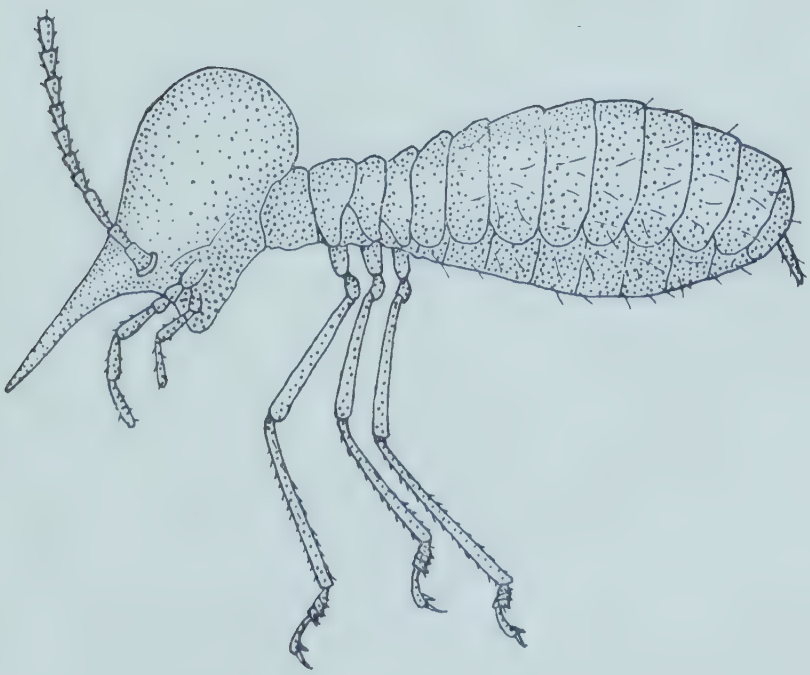
I have said that these termites emerge into the open, so let us try and catch them at nest-building work. How do they excavate their network of galleries? It is not a sight that we can see at any time. But, if fortunate, the following spectacle presents itself. A stream of termites issues from the nest. All belong to the worker class. Each carries a load of excavated material, a small damp pellet of earth, which it casts away on the rubbish heap. The stream moves slowly, carefully, methodically. Though all its members are completely blind, yet they advance with the same certainty as if they had perfect sight. It is obvious that their antennæ feel out the way. The load deposited, they return for more. In fact their manner of excavation is identical with that of the ordinary ant.

But where are the soldiers in this important business? These diggers and carriers are all workers. Not a single soldier takes part in the toil. What is their function? Have they no part in the making of the nest? They have a part, and a very remarkable one. Look along the edge of the excavated earth, the material which the workers are heaping into a mound. There the soldiers have taken their stand. They have formed a ring, a martial circle, a defensive barrier around the heap. Within the circle is the stream of workers carrying and casting down their loads. Both types of soldiers join in this rampart, the large ones are twice the size of the small ones, yet their duties appear to be the same.

Here is a social system most elaborately organized, the peaceful toilers, the martial ring, the military machinery ready for war. It is worth looking at in closer detail. The martial ring is a circle of sentinels. They are fairly evenly distributed: there may be fifty or a hundred of them: they do not run about, but stand stationary in the circle, each keeping to its allotted place. All face outward, their dagger-shaped beaks away from the nest opening, their heads a



Eutermes biformis, WASM, WORKER.



Eutermes biformis, WASM, SOLDIER.

little elevated, antennæ held erect, and trembling as though feeling for danger in the air. It may be only an insect spectacle, a vision of little and unimportant things. But little things are big things when viewed in proportion. And here we see termites with that organized machinery which brutalizes civilized life.

Clearly this is a military system. Let us watch the barbarous machinery at work. I disturb the excavators, the worthy toilers that are carrying out the earth. Instantaneously a retreat is sounded. The labourers make no attempt at resistance. In half a minute all are in the nest. Not a worker is visible; the martial element holds the field. The soldiers, to a man, remain outside. A mad excited frenzy seizes them. They rush about on the heap of debris. Eager for battle, they seek out the enemy. The martial ring disintegrates for fight.

This is the first lesson taught by *Eutermes*. How highly developed is the military machinery amongst creatures so low in the scale. It reminds us of Hymenopteron society with their labourers, their soldiers and their defensive methods. But the militarism of *Eutermes* is more impressive than that of ants. In *Eutermes* the castes, both in structure and strategy, are far more strikingly distinct. Nevertheless ants have sometimes been observed making the same kind of martial ring. But never, I feel sure, with the perfection of *Eutermes*. Moggridge saw *Atta barbara* making rings around its queens to protect them from lizards which would not pass through the ring. Miss Cheesman in the Society Islands saw something similar with *Pheidole*. She gave food to the ants. Their soldiers made a ring around it, kept back all other competitors while the smaller workers took it piecemeal away.

In the higher forms of termites the military organization is well displayed at the nuptial flight. Take *Odontotermes feæ* for example. Workers first break open the galleries. Then the winged forms squeeze their way out, hundreds emerging one after another and ascending into the air. In an hour or more the eruption ceases. Then the breaches have to be repaired. Workers come forward to seal these openings. And now for the first time soldiers appear. They do not come out completely from the galleries. Their method is to remain within the passage and from there line the breach. We see their heads protruding above the margin, clearly keeping a strict guard while the workers seal the opening with clay.

Foraging Expeditions

We leave for a moment these military adventures and turn to more productive manifestations of life. *Eutermes* despatches foraging columns, mainly for the purpose of collecting grass. The expeditions take place in the monsoon evenings, an hour or two before the sun sets. A sharp eye is needed to detect them; for the column of pale flesh-coloured workers is almost invisible against the soil. A course is made for the harvesting area, some suitable patch of grass usually about three or four feet from the nest. A pathway is formed on which the insects move. Their method is like that of harvesting ants. Those facing outward are empty-handed; those

returning are laden with grass. The march is orderly. In coming and going they pass one another, and move without confusion along the path. Each individual with its leafy load reminds us of the leaf-cutting ants of America that advance beneath a Birnam wood. I have seen many thousands on these foraging expeditions; the whole nest seemed to have been abroad. On such occasions they are extremely timid. The slightest interference alarms the mass which turns about and hastens indoors. In the harvesting area we see quiet activity. Some individuals mount the blades, cut off the tips of the vegetation and allow themselves to fall with the separated ends. Others find suitable fragments on the ground, either green cuttings that have dropped from above, or pieces of dried stalks. In the business of transport they are individualistic. Each sticks to its own load. They cannot combine to shift a large mass. Here again they resemble the harvesters and certain of the insect-hunting ants.

Now for the part taken by the soldiers. It is only the workers that cut and carry grass. The soldiers are unfitted for transporting operations, even if they had the instinct to work. Their mouth-parts, as I have said, are shaped into a spear, an implement that could never grip a load. But the soldiers are not absent from these harvesting operations. As in excavating, so in foraging, the warriors have important duties to fulfil. Soldiers mix themselves in the harvesting column. It reminds one of social hymenoptera on the march. Others stand along the foraging track, others scatter around the collecting area, some ascend the blades of grass. Wherever the toilers extend their enterprise, there the soldiers also appear. Their business is to protect the foragers, in the same way as they did the excavators, though the irregular nature of the ground does not lend itself to the martial ring. Interfere with the steady stream of industry. Immediately the soldiers are up in arms ready to attack anything that comes. When alarmed, the foragers set about retirement; the stream of labourers pours back to the nest. But the soldiers remain out until all have disappeared; then the warriors themselves withdraw, forming, as it were, a rearguard to the mass.

Another small experiment shows their military instinct. I kill a worker while it is engaged in foraging. Another worker finds it, drags it towards the termitarium. Soldiers assemble, close around it; a martial ring, or is it a ring of mourners, is formed round the moving corpse. The procession advances, a funereal spectacle, the bier, the corpse, the military assemblage all go steadily into the nest.

Why does *Eutermes* require all this soldiering? What is the particular enemy they fear? I have little doubt that ants are the danger. How often have we seen the ravager, *Lobopelta*, breaking through the earthworks of a termites' nest.

So dangerous to *Eutermes* are insect-hunting ants that the species often builds covered roadways along the surface of the soil. They are nothing like the extensive ramifications of other termites, but are just low tunnels fashioned out of earth. As a rule they are short and project from the nest opening; seldom are they more than an inch or two in length. Such a scanty surface architecture does little

more than guard the entrance to the termitarium. It is all that remains to the foraging species of other termites' pyramids and domes. The building of these roadways is done in daylight; in fact building and provisioning may go on simultaneously. Division of labour exists amongst termites with the same efficiency as in ordinary ants. We see some workers carrying clay from the termitarium, others moulding it to the roof of the passages, while others at the same time collect grass. The foragers keep close to the end of the tunnel, scarcely going farther than half an inch from it. They get hold of the nearest blade of grass, gnaw it off, drag it into the tube. The work is done with apparent timidity. The object of the tunnel is to permit the workers to get without exposure to the nearest patch of grass.

Duties of Soldiers

This is clearly the most interesting point. The soldiers possess two important functions, different from those of the ordinary worker. (1) The function of their antennæ. (2) The function of the pointed beak.

First let us see the function of the antennæ. I uproot a stone, one beneath which a nest is established, and, in doing so, I break through the reticulated walls. Termites burst forth, a violent eruption, which very quickly subsides. Then the work of repair begins. The soldiers seek out the broken galleries; they gather along the edge of the breaches. The ordinary workers for the moment disappear, withdrawing themselves into the labyrinth of tubes. Soon the workers reappear, bringing with them whatever fragments of material they can find, pellets of earth, nodules of grit, pieces of dry grass. A moistening with saliva makes these fragments viscid. Then they are glued into the breach. They are not merely laid in position. The workers with an oscillating movement of the head screw them forcibly into place.

Now let us watch the behaviour of the soldiers. In this work of building they clearly have duties other than those of defence. Collecting along the edge of the rupture, heads turned outward, antennæ expanded, they stand apart at fairly even distances so that the antennæ of each soldier just touches those of its companion on either side. In this we have the strategical ring. But when we watch the soldiers' antennæ we see that they do something more. We notice that they are all the time swaying and touching; they give the impression of estimating distance and in some way measuring the work. I little doubt that they are being used as calculating organs, measuring out the extent of the damage and determining the progress of repair. The soldiers in this way act as supervisors while the workers apply the bricks. The breach now rapidly contracts. Soon the antennæ of the supervising soldiers can touch from opposite sides of the rent. They now know that repair is nearing completion. Hence they withdraw into the gallery; only their heads appear in the breach. Their antennæ still project, gently swaying, and gauging how much remains to be done. Brick after brick is brought by the workers; in the end the soldiers

all but disappear. Only the tips of their antennæ are visible when the last few bricks are moulded to the wall.

Here we have a clear division of labour. Measuring and calculating falls to the soldiers; labourers do the ordinary toil.

Now for the purpose of the pointed beak. Of course this is the organ of defence. While the swarm is engaged at harvesting I place an injured cricket near the nest. This to the termites is a terrible invasion. All the workers rush for the entrance. Soldiers dash in and surround the invader. Some of them shoot jets of poison from their beaks. All their military tactics are called forth. When the workers withdraw the soldiers follow them. As soon as all are safely housed the soldiers take up a position at the gate. A martial group occupies the entrance, their bodies are kept in the interior, their heads appear at the open door. In fact the gate is lined with soldiers, and bristles with antennary threads. Now comes the final act of defence. While the soldiers hold the entrance the workers build a rampart across it. Loads of earth are carried up until the door is firmly sealed. How human-like are these military tactics. First an attack, then a rearguard action, then a picket holding the last defences while a suitable rampart is thrown up. Again we see how like they are to ordinary ants. *Messor barbarus*, for example, under similar circumstances defends the open gate of its formicary by placing across it a barricade of stones.

I have said that, when attacking, they shoot out poison. This brings me to the soldier's spear. The weapon is not particularly sharp, being really a cylindrical tube intended for ejecting spray. When the soldier is annoyed it shoots out from the spear a jet of clear sticky fluid, liquid on emergence, but hardening on exposure. It oozes out like a rope of viscid treacle and then falls in glutinous coils. It has no effect on litmus. Its smell is distinct. Sometimes it comes out in a series of spurts as if driven with definite force. Thus is the spear a defensive weapon, not, however, a penetrating dagger; it is more in the nature of a poison syringe. It must be of great value against natural enemies, of which the carnivorous ants are chief. A rearguard of soldiers standing at a gateway or swarming on the breach of a broken gallery, with their poison spears all directed outward, offer an impregnable front to attack. Woe betide the enemy smeared with their discharge. Its joints, mouth-parts, legs become clogged; gravel, leaves, everything sticks to it. If it does not escape it gets glued to the ground.

Special Senses

Touch.—The antennæ, of course, are the tactile organs. Thrust out in front, they touch every object and carefully explore the way. For the soldiers they seem to serve as measuring implements on those occasions when the passages are under repair.

Smell.—Like ants, they possess a good sense of smell. In one place the stream of foragers led over a smooth stone. I rubbed my finger a number of times across their path. This disturbed them, but only slightly. The line became broken where I had interfered. New arrivals hesitated to cross. My rubbing had done something

which checked their course. Soon, however, they regained confidence. The stream continued as before. Ants, like *Messor*, would have been much more inconvenienced. Yet this incident clearly shows that *Eutermes* has some sense of smell.

When the foraging army was returning to the termitarium, I placed a nodule of camphor in their path. They were instantly aware of it, clearly disliked it. Before ever their antennæ touched it they halted and turned aside. Very soon the whole army was deflected and had to reach the nest by a circuitous route.

Around the nest entrance I made a ring of camphor. The army was abroad. News of the interference quickly reached them. Much alarmed, they called a retirement. But the camphor blocked them. They would not approach it. Though madly determined to reach the next aperture, yet they were utterly cut off. They were as isolated from the termitarium as if it were surrounded by a watery moat.

These simple experiments indicate clearly that termite activities are mainly guided by their keen sense of smell.

Hearing.—Eutermes has a peculiar habit which suggests an auditory sense. When alarmed, they erect themselves, shake their bodies, rapidly and forcibly oscillate their antennæ. Both soldiers and workers adopt this manœuvre. It is very evident when a nest is disturbed, or when a soldier is irritated with a straw. The act is a plan of communicating danger. When one termite erects itself, its neighbours become alarmed. Others at a distance catch the infection ; if the army is abroad the news quickly spreads and in a few moments all are racing for the nest. The communication is not visual. *Eutermes* is blind. Can it have an auditory significance ? Certainly it is very like that of the Red Ant. *Oecophylla* erects itself, jerks its body, hammers the surface of a leaf with its abdomen. A tapping noise is produced in this way, a trumpet that spreads alarm. The vibrations of *Eutermes* give no audible sound, at least nothing that we can hear. Perhaps it is beyond the range of human hearing. For we might anticipate auditory powers in insects deprived of sight.

The suspicion of an auditory sense is strengthened by the fact that Smeathman observed a marching Termite in Africa which emitted a distinct noise. He saw columns of workers issuing from a hole, marching under the direction of enormous soldiers which climbed up the plants and made audible signals to the marching column who responded with a hissing noise. Also Bristowe detected two kinds of noises made by a Brazilian species of termite. He refers to the soldiers of *Conitermes similis*. Some of them jerked their bodies up and down and made a tapping noise by a movement of the chin. Others by sharply crossing their mandibles produced a noise like the snapping of thin glass. More than likely *Eutermes biformis* can emit some sound inaudible to us.

Sight.—A word disposes of this faculty. Both soldiers and workers are totally blind.

Recognition of one another.—Ants, as is well known, are friendly to their comrades, but hostile to members of another community though belonging to the same species. Furthermore we have

reason to believe that each ant can distinguish every other ant within the confines of its own nest. Is there anything of this kind in the termite community ?

I take a worker from one nest and transfer it to a gang of the same species employed at collecting grass. The gang refuses to accept the worker. Indeed they show it every mark of hostility. A soldier meets it. The alarm is sounded. Other soldiers arrive, shoot their poison at it, and soon have it helpless on the ground smeared in viscid juice. Thus *Eutermes* like ants shows communal independence. The members, though all in harmony with one another, are hostile to the members of other nests.

Comparison with Hymenoptera

The chief point that strikes us in this record of behaviour is the close resemblance in small details between *Eutermes* and the Hymenoptera. A termite and an ant are as different in structure as are a dragon-fly and a bee. Yet see their detailed resemblance in behaviour. I do not refer to their social organization, a resemblance that has frequently been pointed out. I am concerned only with details of behaviour as exemplified in this daylight haunting species.

Their mode of excavation is exactly like that of ants, the gang of porters carrying out the loads and pitching them down on the rubbish heap. The protective ring of stalwart soldiers calls to mind a nest of *Camponotus compressus* where idle monsters move about the rubbish heap and smaller labourers eject the earth. We have also seen that *Atta* and *Pheidole* do occasionally manufacture a ring. Disturb *Eutermes*, and the soldiers show fight ; so do the *Camponotus* monsters while the busy toilers hasten underground.[1] How very like are their foraging expeditions to the seed-collecting habits of *Messor barbarus*. We have the common path, the harvesting area, the coming and going with individual loads. Their cutting of the vegetation is like the leaf-collecting *Oecodoma* where each reaps its leafy fragment and bears it away to the nest. Their march is on the plan of the foraging Ecitons, the stream of workers, the scattered soldiers, each with its duty to perform. The building of arcades is done by *E. vastator* which spreads along the ground a covered roadway underneath which the workers advance.

Ants are renowned for their division of labour. With *Eutermes* we have excavators, builders, provisioners, each to its own task. Their rampart of defence is the plan of *Messor barbarus* which keeps out the enemy with a barricade of stones. Ants are particular in disposing of their dead. We are even given an instance of a funeral procession where a long and organized stream of workers followed the corpse to a special grave. Such a story might be thought to be purely imaginary. Yet what have we seen in *Eutermes biformis* ? ; a funeral ring encircling the corpse and retiring with it into the nest. Their sensory capacities are in many ways like those of ants. Their sense of smell seems identical with that of *Messor barbarus* which

[1] The habits of these Indian species of ants have been described in *A Naturalist in Himalaya* and *A Naturalist in Hindustan*.

camphor distracts in exactly the same way. They communicate danger by shakings and jerkings, not at all unlike the plan that *Oecophylla* adopts. Lastly we see that recognition characteristic of ants in which the members of a community are friendly to one another but hostile to the members of other nests.

I conclude with a quotation from Professor Wheeler. He is referring to termite communities far more highly organized than mine. 'When we reflect that ants and termites have been able, through slow physiological and instinctive processes, independently to evolve such strikingly analogous peculiarities as those I have described, we can scarcely doubt that different human communities, belonging to the same species and endowed with some intelligence, may frequently have hit upon the same inventions.'

FURTHER NOTES ON BIRDS ABOUT SIMLA

BY

HUGH WHISTLER, F.L.S., F.Z.S.

In Vol. xxvi of the Journal, pages 770–775, I recorded a series of observations made about Fagoo near Simla in 1918 and followed it up in Vol. xxvii, pages 94–111, with a further series of notes made in 1919 in Simla. As it was my good fortune to be posted as Superintendent of Police, Simla, for the season of 1925 and as there is no liklihood that I shall ever visit the Simla Hills again, I take this opportunity of setting on record the more interesting of my notes made in that year. I arrived at Simla on February 6, 1925 and left it again on October 23 of the same year. Before the season started I was able to make short tours to Sabathu, Dagshai and Solon from February 27 to March 4 and to Narkunda, Koteghar and Kotekhai in the second half of March. For the rest of the time I was confined to Simla or localities within reach of a day's expedition.

Nucifraga hemispila, Vigors. The Himalayan Nutcracker.

Common from about 6,000–9,000′ in the hills behind Simla as near as Mashobra and Mahasoo but not observed in Simla itself. I found it very common and in pairs about Narkundah from March 13 to 16 and found a nest on March 16 built in the branches of a pine close to the trunk at no great height from the ground. One bird was sitting in the nest and both made a great fuss when I examined it, so I was surprised to find that it contained a single dead chick. Both sexes apparently take part in incubation.

The flight is very similar to that of a Jay—very flapping with rounded wings and the same rather hesitating manner combined with fair speed.

Stachyridopsis pyrrhops (Blyth). The Red-billed Babbler.

A few pairs were seen at Sabathu when I was there from February 23 to 27. One was seen at Kotekhai on March 20, a pair were seen at 7,000′ in the Chirot Nala, Mahasoo on June 14.

Cephalopyrus flammiceps flammiceps (Burton). The Fire Cap.

On March 21, two flocks were met with in some willows in the Giri Valley above Parala; they were singing a low twittering song rather like a feeble version of the song of the Goldfronted Serin (*Serinus pusillus*).

It was reported as first seen in Simla on March 27 and on April 1 a pair were found building near Snowdon. This nest contained four rather incubated eggs on April 21.

On May 8 I found a pair feeding well-grown young in 7,500′ on Jakko. The nest was in a hole in an Oaktree trunk about 20′ from the ground.

Horeites pallidus pallidus, Brooks. The Pale-bush Warbler.

Several were observed about Kotekhai in the Giri Valley on March 20–21 and the song was also heard there once.

This species breeds in fair numbers about 8,000′ at Mahasoo and Kufri and from May to August the characteristic song may be freely heard in the thick undergrowth that clothes the hillsides wherever the larger forest trees have been cut. It is probably double brooded as on August 9 I found a brood of newly fledged young clicking and skulking in a rough patch of cover in the cultivation above the Kufri bazaar.

Sturnus vulgaris poltaratzskyi. Finsch. Finsch's Starling.

A solitary female of this species was found about three miles below Kotekhai in the Giri Valley on March 19. It was in poor plumage and was consorting with Common Mynahs.

Acridotheres tristis (L.). The Mynah.

Common at Dagshai 5,000′ and Sabathu in February, at 7,200′ at Koteghar in March and at Kotekhai in March.

Tarsiger chrysæus whistleri, Ticehurst. The Golden Bush-Robin.

A female was found at about 6,500′ in the Chirot Nala on March 29.

Oreocincla mollissima simlaiensis, S–B. The Plain-backed Mountain-Thrush.
I shot a male on Jakko at 8,000′ on February 14 ; another Mountain-Thrush seen the same day and on February 11 also on Jakko was probably of the same species.

Carpodacus thurus blythi (Biddulph). The White-browed Rose-Finch.
I shot an immature male (in the plumage resembling that of the female) at 8,000′ Kufri on February 22, 1925. It was a solitary bird and was feeding on the ground in a light sallow thicket on the top of the Kufri ridge. This appears to be the first record of this species in the Punjab Province.

Callacanthis burtoni (Gould). The Red-browed Finch.
I saw a male on February 17 and two females on February 18, in both cases feeding on the bank above the mall close to Gorton Castle. A flock of about thirty were seen by a friend on March 1, feeding by the side of the cartroad below the Cecil Hotel. These birds are very tame and have the movements on the ground of a heavy sparrow.

Serinus pusillus (Pallas). The Gold-fronted Serin.
On February 27, I found a flock on the cartroad about a mile from Sabathu. From March 19 to 21, I met with some parties in the Giri Valley between Parala and Kotkhai. A single bird was heard at 6,000′ on the southern face of Tara Devi by the cartroad on April 10.

Fringilla montifringilla, L. The Brambling.
I have now to recant the former opinion expressed by me in the Journal (Vol. xxx, p. 410) that there must be some mistake about Jerdon's record that the Brambling occurred at Simla.
On December 13, 1924, Mr. A. E. Jones obtained a female in his garden at Marston Grange (7,000′).
Then on February 15 and 22, I met personally with several in the cultivation at 8,000′ above Kufri bazaar. They were in company with the flocks of Stoliczka's Mountain-Finch that were common on the hillside amongst the snow and owing to the restless behaviour of the latter species were hard to obtain when with them. However, the Bramblings at times liked to rest quietly in the leafy boughs of the Mountain Oaks and were then easy to approach.
When I visited the same place on March 10, I could only find a single female in a huge flock of the Mountain Finches.
In all I obtained five specimens.

Æthopyga gouldiæ (Vigors). Mrs. Gould's Sunbird.
On April 5, I saw a brilliant adult male in the Chirot Nala at about 6,500′ ; it was hovering in the undergrowth apparently collecting spiders threads for its nest and then dashed away into the forest out of sight. The call is a note like the rapid opening and closing of a pair of scissors as in the case of *Æ. siparaja*. Near the same spot on July 12, I shot two young males. They were moving about some parasitic plants at the top of a lofty oak tree, turning incessantly from side to side and uttering the same scissor's note.

Dicæum ignipectum (Hodgson). The Fire-breasted Flowerpecker.
On February 24–25, I found several of these little birds about Sabathu Cantonment.

Dryobates hyperythrus (Vigors). The Rufous-bellied Pied Woodpecker.
A male was seen in the pine woods of Narkundah at 9,000′ on March 16.

Apus melba (L). The Alpine Swift.
A few Alpine Swifts were noted in the vicinity of Simla on various dates from April 11 to May 17.
On the autumn migration however they were observed in much larger numbers than is usual about Simla, and for a longer period ; the first birds were seen on August 21 and the last on September 24 ; between those two dates I have records of flocks seen on sixteen different days, on some days in very large numbers.

Cacomantis merulinus passerinus (Vahl.) The Indian Plaintive Cuckoo.
I heard this little Cuckoo on July 15 calling in a valley about 5,500′, below Kasumpti.

Strix aluco nivicola (Blyth). The Himalayan Wood-Owl.

On April 4 I found one of these delightful birds sitting in a holly oak bush near the ground and it allowed me to look at it from a distance of about 4 feet. It then flew off and settled near the ground in another tree. This was at 7,800′ on Jakko where the species may be heard calling at nights.

On July 12 I found two adults sitting in the undergrowth of wattle bushes at 7,300′ by the private road in the Chirot Nullah.

Strix indranee indranee (Sykes). The Brown Wood-Owl.

Only observed on one occasion (April 16) in a nullah just above Annandale in the late afternoon.

Otus spilocephalus (Blyth). The Spotted Himalayan Scops-Owl.

The characteristic call of this little owl was heard in the grounds of Viceregal Lodge on October 21.

Glaucidium brodiei (Burton). The Collared Pigmy Owlet.

This Pigmy Owlet must be quite common in and about Simla and the neighbouring hills as I heard it calling on various dates from February 20 to May 17 after which the call was not heard. A female was shot at Dagshai 5,700′ on March 2 and I observed it up to 9,000′ at Narkunda. It calls both by day and night, and is active by daylight.

Torgos calvus (Scop). The King-Vulture.

Observed as follows :—February 27 Dharmpore, March 2 Dagshai, March 3 Solon, March 8 over Tara Devi and Simla W., March 10 beyond Sanjouli, March 18, Theog, April 5 by the Tollbar. After that it was not seen.

Pseudogyps bengalensis (Gm.) The White-backed Vulture.

Observed as follows :—March 2 Dagshai, March 8 two or three on Tara Devi, May 10 about Naldera.

Gypaëtus barbatus hemachalanus, Hutton. The Lämmergayer.

On September 24 an adult Lämmergayer was brought in to Mr. A. E. Jones by some hill men, who declared that they had caught it in some telegraph wires. Although we could detect no sign of injury it was very quiet in demeanour sitting passively on the floor, a little inclined to bite if molested but otherwise still and silent ; it kept the head rather lowered and the mouth a little open. If uninjured it may have felt conscious of the hopelessness of opening its huge wings for flight in the restricted area of the room. Mr. Jones kindly allowed me to present this bird to the Society and its portrait appears in our Journal (Vol. xxxi, 198).

Hieraëtus fasciatus (Vieill). Bonelli's Eagle.

Bonelli's Eagle was seen from the railway between Solon and Tara Devi on March 2. Single birds, apparently of this species, were seen soaring over the Hotel Cecil on March 9 and by Parala in the Giri Valley on March 21.

Spilornis cheela (Latham). The Crested Serpent Eagle.

Occasionally observed about the catchment area from April to July.

Ictinaëtus malayensis perniger (Hodgson). The Black Eagle.

As there is little on record regarding this fine Eagle in the Western Himalayas it seems worth while recording my experience of it in detail.

On March 14 and 16 I saw an Eagle, which was almost certainly of this species, soaring about Sidhpur 8,500′-9,000′ between Koteghar and Narkunda, and on the latter date it also flew over Narkunda.

What was perhaps another was seen on May 10 near the Retreat, Mashobra.

On June 28 I had a splendid view of one hunting in the bottom of the Chirot Nala (catchment area) at about 7,000′. It was very dark in appearance, save for a light area in the primaries and the marked bars on the tail. The yellow at the base of the beak was very noticeable. It was a wonderful flier covering the sides of the nullah in circular beats, practically without flapping the wings. The wings and tail looked very broad and rounded, the primaries spreading out like the fingers of a hand.

On August 16 I secured a fine male at Kufri 8,000′. This was in complete moult with the organs very indistinct. In the crop was a naked nestling of

some passerine bird, apparently *Trochalopteron lineatum* and in the stomach incubated eggs of a Laughing Thrush either *T. variegatum* or *T. erythrocephalum*. It seems fair therefore to assume that the marvellous powers of flight are devoted in the summer months chiefly to bird nesting and that as the Eagle quarters the hillsides it is scanning the bushes for nests. This is the only specimen of the Black Eagle I have ever secured personally and the thrill that the incident afforded will perhaps excuse the inclusion of the following extract from my diary :—

"We emerged out of the forest on to a bare spur and looked down into the head of the nullah which lay below us a thousand feet, breaking up into numerous side ravines, partly clothed in forest, and partly bare or clothed with undergrowth, in places almost precipitous. There, far below us was a Black Eagle which was hunting over the trees and undergrowth in regular beats, backwards and forwards, sailing in and out of the nullahs and contours with the utmost ease and grace. This he was doing in the head of the main nullah, and then he started to beat up the side towards where we were resting, after one false alarm in which he started towards our side and then returned to the main nullah. I told my companions to remain absolutely still without moving hand or foot as we were out in the open as the Eagle worked along the sides of the nullah, quartering the ground backwards and forwards but all the while gradually advancing in our direction, I saw that his course was steadily ascending and would probably bring him into the gap between some trees on my left. For a moment he went out of sight in a nullah so I hastily shifted a yard or two to cover that gap and waited with my 410 collecting gun (No. 8 shot) ready and cocked. In my new position I could no longer see the hillside and watch the progress of the bird but a minute or two later it suddenly sailed into the gap in front of me, and seeing me steered off to drift down hill. I fired and hit the bird which staggered and again recovered, and turning made off in the direction in which it had come ; but it was obvious that it had been hard hit. We watched it keenly as it went, and it disappeared into the deodars that clothed a side nullah ; however it did not reappear on the far side of the nullah, nor could we see it elsewhere. Obviously it had stopped in the nullah, so leaving Major C. to watch from our spur I made off down the hillside with my orderly Tulsi Ram as fast as might be consistent with caution.

I entered the deodars very quietly with gun ready loaded and every nerve on the *qui vive* to detect the wounded Eagle resting in a tree, or to hear the sound of small birds mobbing it. The sunlight and the shadow were very peaceful and quiet, and the only calls came from a large party of Grosbeaks in the trees and some Variegated Laughing Thrushes—but these all were obviously concerned only with their own affairs. There was no sign of my quarry. I passed through the nullah and emerged on to the ridge beyond and then signalled and shouted to Major C. perched on the spur above, with his handkerchief fluttering in the breeze to show his position. He replied that there was still no sign of the bird. Tulsi Ram and I then worked back into the nullah, taking different lines, and a welcome shout soon announced that Tulsi Ram had found the Eagle lying dead in a tree."

Accipiter virgatus affinis, J. E. Gray. The Besra Sparrow-Hawk.

The late Mr. Basil-Edwards kindly allowed me to examine a beautiful adult male Besra that he shot at Simla 6,000′, on June 28, 1925.

On June 18 I found a nest of the Chestnut-bellied Rock-Thrush at 8,000′ on a pineclad slope of the Chirot Nala. It contained two well-feathered chicks which as I looked at them dashed out of the nest and down the hillside. At once there was an agitated skirmish which resolved itself into the parent Rock-Thrushes trying to save the chicks from a tiny hawk, which dashed at them in a most determined manner regardless of my presence and successfully carried one of them off. This Hawk could only have been the adult male of this species, and I saw what was probably the same bird at the bottom of the nullah on July 12.

Falco peregrinator, Sund. The Shahin Falcon.

In March I found a pair of Shahins frequenting the face of a mountain close to Simla and on April 10 I discovered what was evidently the site of their eyrie in a precipice ; it was however quite inaccessible. The same birds or others were seen over Simla occasionally in June and July.

Falco subbuteo, L. The Hobby.

During the summer months the Hobby is distincly scarce in the neighbourhood of Simla and I did not hear of it until May 7, when one was reported as seen flying over the Ridge. It does however breed in the vicinity, as will be seen from the following account taken from my diary :—

"On the evening of June 17, 1925, I went out to examine a certain ridge near Simla, on which the Hobby Falcon has been known to breed for at least 10 or 12 years. The upper slopes of this ridge, looking towards the S. W. are broken by small nullahs, and covered with a fairly thick growth of Deodar forest, of no great age.

I started towards the top of the hill and commenced to work downwards in hopes of finding the whereabouts of the Hobbies. I had not gone far before I heard the screaming of a Falcon below me and was able to track it into a small nullah filled with Deodars. I accordingly took up a position on the ridge at one side of the nullah and settled to watch. It was not long before I made out a Hobby sitting in a Deodar tree where it was calling and after a short time the other bird also appeared. Both Hobbies were very noisy screaming at intervals the plaintive rising *tee—tee—tee—tee* which is common to most of the Falcons, and varying it occasionally with a harsh single note *pit pit* or *chip chip chip* uttered two or three times in succession. They kept on flying about in circles, sometimes over the trees, sometimes amongst them and often low over the ground, settling here and there on different trees.

One of the Hobbies was carrying something in its talons—apparently a small bird—which it eventually ate on a Deodar.

This behaviour went on for sometime and I then left the place without disturbing the birds.

There was no doubt from their excitement that they were preparing to breed, and I noticed a crow's nest in very good condition which seemed a likely nest for them to use, though they did not directly approach it while I was there. It was about 40′ from the ground against the trunk of one of the Deodars overhanging a mule road that wound through the nullah. This spot is at an elevation of about 6,500′.

On June 24, 1925, I returned to the spot about 5 p.m. walking along the mule road and as I approached the site of the Crow's nest the little male Hobby was visible sitting on the topmost shoot of a tall Deodar about 20 yards away. He paid no attention to me and the female was not visible anywhere so I climbed up on to the ridge, where I had sat before, and made myself comfortable to watch.

The little Falcon was sitting there on his lofty perch in complete ease, looking over the wide valley that stretched before him with portions of Simla visible on the ridges across the other side. It was cool and pleasant with a bright sun and though he was sitting quite very much at his ease he was all the time on the alert, his head turning from side to side incessantly. After a time he started to stretch himself and show systems of preparing to move, then he flew off circled once in the air and disappeared over the ridge for his evening's hunting and I did not see him again.

I waited there for sometime longer but the female did not appear and nothing happened. Then I climbed along the hillside to a spot whence I could see onto the top of the crow's nest noted at my previous visit, and there was the female sitting in the nest, where she had obviously been all the time. So without disturbing her I went away determined to allow ample time for the eggs to be laid.

On June 27 I returned to take the eggs. As we arrived at the spot there was complete silence and the male could not be seen on any of the trees, nor from below could we distinguish any bird in the nest. I had a sinking feeling that something was wrong and that the prize was not to be mine : however I told Tulsi Ram, my orderly, to go up the tree and he divested himself of his haversack and coat and started : he was not more than a quarter of the way upto the nest when the female Hobby flew out of the nest screaming once or twice and settled on a bough of a Deodar some 30 yards away. There she sat more or less unconcerned and took but little notice of the climber.

He reached the nest and reported three eggs and said that the nest was quite small and that there was no food lying about it. I told him to take the eggs and substitute for them a couple of hen's eggs, slightly smeared with mud to darken them, which we had brought for the purpose. This he did and des-

cended again. We then stayed on the road below the nest examining and packing the eggs but almost as soon as the climber was down the Hobby took to wing and flying in a circle round the nest tree settled in a neighbouring Deodar. This she repeated again, flying close to the hillside, and after one or two more short flights she returned to the nest and settled herself down in it on the hen's eggs.

We then climbed up to the usual knoll and settled there to watch ; the female Hobby was visible through the glasses sitting very deep in the nest cavity, her back below the line of the sides of the nest ; her head was a little higher but hardly able to see over the side, her tail projecting rather upwards over one side.

For a time nothing happened : then in the distance I heard the screaming call and the male Hobby appeared from out over the valley flying rapidly towards the site of the nest : as he approached it was evident that there was food in his talons and he circled once past the nest calling, while the female answered, and after that he settled on a neighbouring Deodar. Here he sat on a horizontal bough and I could see he was carrying the partially plumed body of a small bird. The female slipped off the nest and settled in another neighbouring Deodar. The male kept on calling sometimes a sharp *pit pit pit*, sometimes the familiar screaming call, while the female answered in the same way and flew from perch to perch. Then the male took the bird in his beak and the female flew on to the bough beside him, took it in her beak, transferred it to her claws and flew away and settled in the Deodars further up the nullah where we could not see her. The male relieved of his burden cleaned his beak against the bough, preened his feathers, and then settled himself to sit patiently on the bough.

In a comparatively short space of time the female re-appeared having eaten the bird ; she then took some exercise circling in the air and settling in the various trees, calling a good deal in the process while the male sat quietly in his place ; finally she flew down to the nest and settled on the edge of it where she stood looking about her ; then she stepped down into the egg cavity and stood there, and gradually settled down sometimes putting her head down to look at or move the eggs ; and before she finally was satisfied she changed her position in the nest by a half circle.

When she was definitely settled on the eggs, I went down and had the male flushed and shot him, as the specimen was required. His crop was empty but there were a few fragments of flesh and feather in the stomach probably eaten while pluming the bird he had brought for the female. The report of the gun brought the female off the nest calling but she settled at once in a neighbouring tree and ultimately returned to the nest in which we left her sitting. Two days later I sent the orderly to remove the hen's eggs and he reported that the female Hobby was not at the nest, so she probably had deserted it on finding that the male had vanished.

In October there was a most marked migration of Hobbies in the Simla Hills. On October 3 three were visible high over the Ridge at dusk. On October 9 one was reported to me and I saw a second bird that had been shot.

On October 11 Hobbies were visible in the Chirot Nullah all day on the wing most of the time. There were at least 5 and probably more. I noticed that while the bird was soaring the primaries slanted slightly downwards, almost below the level of the back, while the bird moved in curves and circles climbing and sinking at will in the air with scarcely an effort—an occasionally shifting of the angles of the wings and two or three rapid strokes of the wings now and again being all the effort involved. Thus the Hobby soared for a space, then there would be a burst of activity and the bird flew straight with regular rapid wing beats ; next followed a swift downward stoop of a hundred feet, and again the bird was rising swiftly without effort. Thus were the Hobbies feeding or playing all day long, backwards and forwards, up and down, over the steep bare hillsides and the deep cut ravines. I shot an adult and an immature bird ; both were exceedingly fat and the former had its crop stuffed with remains of insects, apparently cicadas.

After returning to Simla I saw two more Hobbies by the Grand Hotel in the evening.

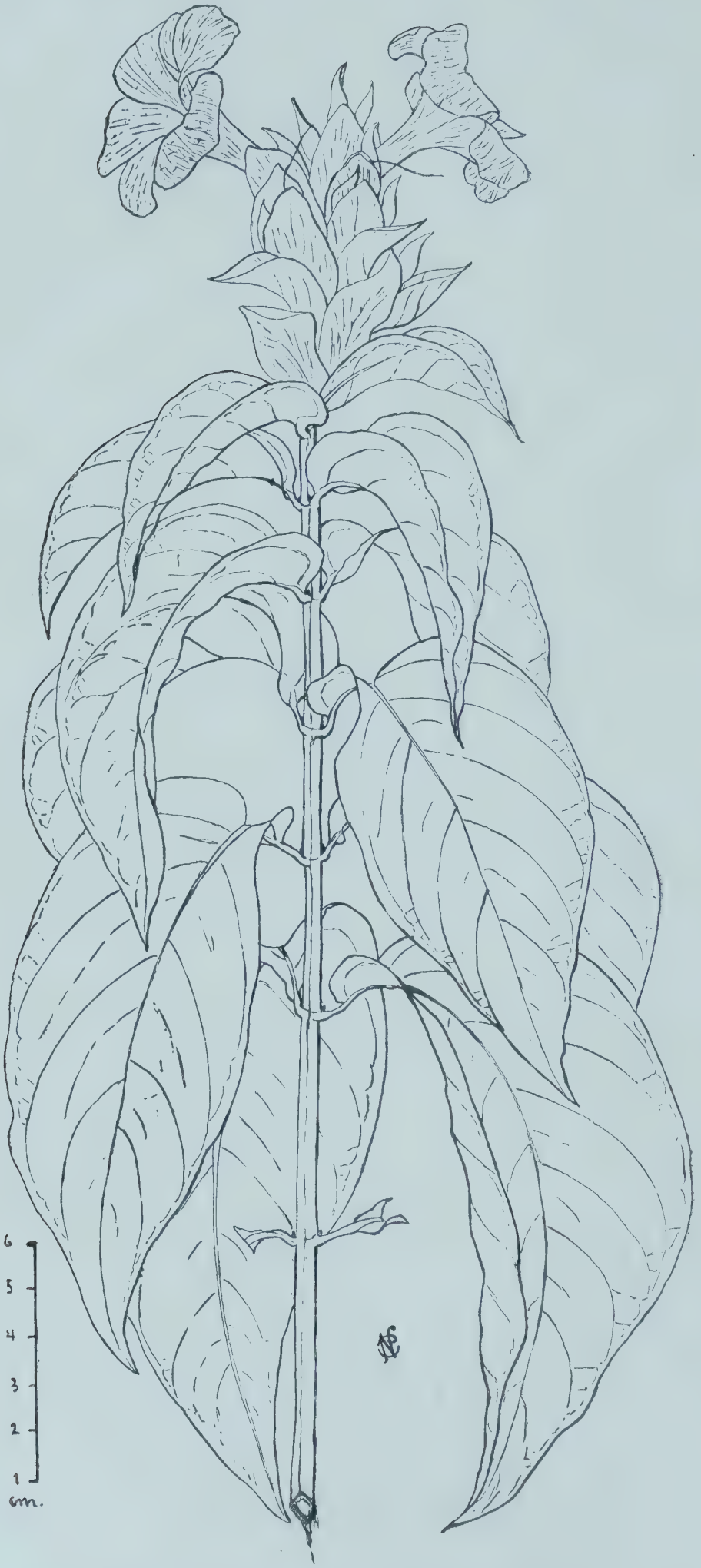
On October 13 I saw one– or perhaps more—at dusk soaring high over Gorton Castle. On October 15 I saw two at dusk high over Snowdon. The same

evening there were said to be about a dozen over Mashobra and one was shot and sent to me to substantiate the record.

These birds must have moved on immediately as on October 18 I saw none in the course of a long day over towards Kufri, though the next evening at dusk saw a single bird over the Ridge.

Arboricola torqueola millardi, Stuart Baker. The Hill-Partridge.

I attribute to this species a characteristic call of the Simla hills, a very gentle melancholy *poor* or *pheaw*, which at closer quarters sounds more like *quaaw* ; it is uttered singly at short intervals and the sound carries for a long distance, being audible throughout a whole nullah. This call may be heard from 6,000 to 8,000' in the Simla hills throughout May and June and the first half of July and occasionally at other times. If my attribution is correct the Hill-Partridge must be fairly common, though I only occasionally flushed a pair on forest-clad hillsides.



Barleria Gibsonioides, BLATTER, SP. NOV.

Del. Norah Coady.

SOME NEW SPECIES OF PLANTS FROM THE WESTERN GHATS

BY

E. BLATTER AND C. MCCANN

(*With a Plate*)

Barleria Gibsonioides, Blatter, *sp. nov.* [Acanthacea sectionis Eubarleriæ, similis Barleriæ Gibsoni, Dalz. a qua tamen recedit bracteis basi semper late rotundis, sepalis interioribus glabris exceptis marginibus ciliolatis, corolla minime glabra, seminibus discoideis, colore corollae].

A tufted undershrub, up to 1 m. high, very leafy. Stems quadrangular, very obscurely winged, stiff, erect, light green ; internodes thickened above the leaves. Leaves glabrous, except the margin which is finely spinous-hairy, leathery or papery, somewhat rigid, lowest broadly ovate or almost rounded, obtuse at the tip, lamina up to 14 cm. by up to 10 cm., the rest ovate-oblong or ob ong, acuminate, up to 20 cm. by 8 cm., very variable in size and shape, shining-green above, glaucous beneath, base rounded or tapering, main nerves up to 7 pairs, depressed and whitish above, prominent beneath ; stalks of lowest leaves up to 4 cm. long, getting shorter upwards. Flowers in dense, imbricate, terminal spikes, rarely solitary, axillary ; spikes more or less 10 cm. long in flower. Bracts foliaceous, the lowest 1 or 2 pairs resembling the leaves and up to 10 cm. long, the rest getting rapidly shorter upwards and shorter than the calyx, broadly elliptic-lanceolate, acute, broadly rotund at the base, pale-green. Bracteoles at base of stalkless flower, linear, boat-shaped, subacute, glabrous on both surfaces, margin ciliolate, up to 2 cm. by 2 mm. Outer sepals 2, ellipsoid, rounded at base, up to 5 cm. long and 2–2½ cm. broad, often exactly alike as to size and shape, but one generally slightly shorter and subacute at the apex, the other acute, both distinctly nerved, quite glabrous, glaucous on the lower surface, pale green and shining on the upper ; inner sepals 2, narrowly linear-lanceolate, acuminate, boat-shaped, up to 15 mm. long, 2–3 mm. broad, glabrous, with ciliolate margin. Corolla 6–10 cm. long, minutely glandular-hairy on the margin and tube, sparingly so on the surface of the lobes ; tube 4–5 cm. long, enlarged upwards, dark purple inside and outside, lobes obovate or ellipsoid, rounded at the apex, delicately veined, mauve (light and dark), the 2 upper lobes each with a large elongated dark purple blotch beginning at base of lobe and extending 15–20 mm., blotches sometimes faint or absent. Stamens 2 ; filaments white in the lower part, mauve in the upper ; anthers violet ; pollen globose, white. Staminodes 3, without anthers. Base of stamens and staminodes minutely glandular-hairy. Style filamentous, white in the lower part, mauve above. Stigma bifid. Unripe capsule oblong, tip conical, shining, smooth. Seeds 4, disc-shaped, glabrous. [PLATE I.]

Very variable as to size and shape of leaves even on the same plant. In open situations the leaves are shorter, thicker, stiffer, and darker green on the upper surface, whilst when growing amongst other vegetation, they are longer, narrower, thinner and lighter green. In the latter surroundings the internodes of the stem are considerably thinner and longer. The flowers, too, vary a good deal as to size and shape of the corolla-lobes. On drying the upper side of the leaves turns black, the lower bluish-grey.

Locality : Below Godowli, 3 miles from Panchgani, W. Ghats of Bombay Presidency (Blatter Nos. 1, 2, 3, 5, 7 type, 4, 6, co-type). Was in flower during the first half of October 1927.

Crinum Eleonorae, Blatter & McCann, *sp. nov.* [Amaryllidacea Sectionis Brachynematis, similis Crino brachynemati, Herbert, a quo tamen differt collo robusto longo, staminum filamentis longioribus, antheris duplo longioribus, stylo quam filamentis multo longioribus].

Bulb ovoid or almost spherical, up to 20 by 13 cm., narrowed into a stout neck about 8 cm. long, clothed with old pale leaf-sheaths. Leaves appearing

after the flowers, ensiform, with obtuse apex up to 60 cm. long and 5 cm. broad, not very firm, fairly thin, dark green, glabrous, with the margins entire. Scape lateral, up to 50 cm. long, reaching 2·5 cm. diam., cylindrical, but slightly compressed, green, tinged with purple. Flowers white, strongly scented up to 20 in an umbel, nodding. Bracts 2, broadly lanceolate, obtuse or acute, with broadly inflexed and thickened margin, 9 by 3·3 cm., green, tinged with purple outside, pale inside. Bracteoles linear, up to 9 cm. long, green, tinged with purple. Pedicels up to 1 cm. long, stout. Perianth funnel-shaped, tube green, tinged with purple, or greenish and becoming paler towards tip, up to 6·5 cm. long, cylindric at base, then becoming 4-sided with rounded angles; lobes up to 7·5 cm. long and 2·2 cm. broad, lanceolate, the inner ones sometimes oblanceolate, cuspidate, reflexed and slightly concave at the tip, with a longer cusp in bud, pure white, sometimes tinged with purple along the median line on the back; the buds are cream-coloured and the purple tinge is more pronounced. Filaments on the throat of the perianth-tube, free, filiform, purple, 1 cm. long; anthers in young buds yellow, then (whilst still in the bud) getting black and only yellow along the open slits, dorsifixed, up to 15 mm. long, oblong, twisted when dry. Style filiform, included in the tube, up to 5 cm. long, white in the lower part, purple above. Fruit not seen.

The anthers open in the bud.

Locality: Lingmala near Mahableshwar, open hill-sides and on both sides of the river above the Yenna Falls, also half-way between Panchgani and Mahableshwar (McCann Nos. 7, 8, 9, 10, type).

Forma purpurea.—McCann found specimens in the same localities with the perigone-segments oblanceolate, deeply tinged with purple on the dorsal side, and the perigone-tube with the bracts uniformly brown-purple. (McCann No. 11, type.)

In flower: End of April and beginning of May.

Iphigenia stellata, Blatter, *sp. nov.* [Liliacea, similis Iphigeniæ, indicæ A. Gray, differt tamen ab ea floribus duplo majoribus, petalis minime unguiculatis, oblongis vel oblongo-lanceolatis, vel oblongo-obovatis, non lineari-subulatis, mucronatis vel acuminatis].

Corm subglobose, 10–18 mm. in diam., narrowed into a short hypogæal neck, tunicate with light-brown membranous sheaths. Stem up to 10 cm. high, rigid to flexuous. Leaves alternate, 2–4, grass-like, sessile, the lower up to 12 by 1 cm., all about the same size, linear or linear-lanceolate, tip acute-mucronate, coriaceous, rigid, keeled, shining on both surfaces, base long-sheathing; midrib depressed on upper surface, nerves many, up to about 12, obscure above, very prominent beneath. Flowers various hues from pale to dark mauve, cream-coloured in bud, up to 7 in a terminal short raceme. Bracts linear or linear-lanceolate, resembling the leaves, up to 6 cm. long. Pedicels 12–20 mm. long, stout, thickened below the flower, deeply 6-grooved, each ridge supporting a petal. Perianth-segments up to 15 mm. long, up to 4 mm. broad in the middle, oblong or oblong-lanceolate, or oblong-obovate, mucronate or acuminate, not clawed, spreading. Stamens up to 5 mm. long, purple; filaments rigid, straight, slightly flattened on inner surface; anthers 1–1·5 mm. long, versatile, purple; pollen yellow. Ovary green, slightly shorter than the stamens, oblong-trigonous, 6-sulcate; styles 3, 2 mm. long, united at the base for about $\frac{1}{3}$ their length, recurved, dark purple, stigmatic surface beginning with the curve of the styles; ovules ovoid-oblong. Capsule almost globose, or obovate or oblong-obovate, loculicidal, up to 8 mm. long, deep grooves between the carpels, shallow grooves on back of carpels, styles and stigmas persistent. Seeds subglobose or ovoid, 2 mm. long, slightly irregular, flattened on one side, umbonate, yellow testa very thin.

Like *I. indica* very variable and resembling it at first sight. Can always be distinguished by the much larger flowers and by the shape of the clawless petals.

Locality: Tableland of Panchgani, W. Ghats of Bombay Presidency, fairly common (Blatter P1 type), also found on Second and Third Tableland, on Tableland near Mahomedan School.

Was found in flower about the middle of June, 1925. There had been some heavy showers at the end of May and beginning of June.

Fruit noted about the middle of August.

Urginea polyantha, Blatter & McCann, *sp. nov.* [Liliacea similis Urgineæ indicæ, Kunth, sed recedit ab ea pedicellis brevibus nunquam deflexis, racemo denso multifloro, perianthio rotato, perianthii segmentis omnibus apice barbatis, staminibus brevioribus, stylo cylindrico, capsula apice truncata].

Bulb globose-ovoid, tunicate, pale, up to 5 by 4·5 cm., neck 3·5 cm. long, conical. Leaves appearing after the flowers, not observed. Scape up to 60 cm. high, up to 4 mm. diam. at the base, slender, rigid, slightly bent at tip, greenish to purple, dense-flowered. Flowers many, up to 50, about 1 cm. and less apart on the raceme up to 25 cm. long. Pedicels filiform, up to 6 mm. long, spreading in flower, ascending or appressed and almost double the length in fruit. Bracts deltoid, about 1 mm. long, often still visible in fruit. Flower-buds brownish-purple, obovate when very young, gradually becoming clavate. Perianth rotate, pale yellowish-green inside, with a broad brownish band along the centre outside; segments oblong, 5–6 mm. long, bearded at tip, outer ones 3 mm. broad, inner 2–2·5 mm. broad, obtuse. Stamens whitish, 2·5 mm. long; filaments flattened, getting very thin upwards; anthers versatile, cordate at base. Ovary oblong, 6-grooved. Style short, stout, uniformly thick throughout, 3-grooved. Stigma trigonous. Capsule up to 10 by 6 mm., broadly ovoid-oblong or broadly ellipsoid, truncate at tip, coriaceous, triquetrous, each carpel with an elevated groove in centre and with a slightly higher rib on margin. Cells 2–10-seeded. Seeds broadly ellipsoid, sometimes irregularly toothed at upper end, broadly winged, up to 6 by 5 mm., flat, shining black, seed without wing pear-shaped, flat.

Tetramerous ovaries have been observed. The flowers open before dawn and remain open till about noon. The perianth encloses the fruit till the latter reaches half the final size and then falls away.

Can be distinguished from *U. Wightiana*, Hook. f. by the much denser racemes, the shorter pedicels, the shorter and broader perianth-segments, the flowers not drooping, the seeds not being orbicular, and by the deltoid bracts.

In *U. coromandeliana*, Hook. f. the flowers are drooping and have longer pedicels, only the inner perianth-segments are bearded at the tip, and the style is obconic.

Locality: Amongst short grass on Tableland of Panchgani, W. Ghats of Bombay Presidency, 4,400 ft., very common in some patches, less common on slope of Tableland (Blatter and McCann No. 101, type).

Flowered from the middle of March to end of April, 1926.

Dipcadi Ursulae, Blatter, *sp. nov.* [Pertinet ad familiam Liliacearum; accedit ad Dipcadi montanum, Baker, a quo tamen recedit foliis latioribus, scapo tereti, bracteis ovatis longe-acuminatis quam pedicelli multo longioribus, pedicellis in vivo robustis minime filiformibus, perianthii lobis exterioribus quam tubus multo longioribus.].

Bulb globose, small, about 20 mm. in diam., tunicate, with many white fibres from the base. Leaves 4–5, leathery, 15-30 cm. long, up to 7 mm. broad, linear, plicate, grass-green, sheathing at the underground base. Scape green, terete, 15–30 cm. long, smooth, naked. Flowers when in bud in dense racemes of 6–12 flowers, ultimately the raceme becoming lax and reaching up to 12 cm. long. Bracts caducous, ovate, long-acuminate, 10–26 mm. long, reaching 2–3 mm. beyond the bud, centre green, margin in the lower part or the whole scarious. Pedicels 6–9 mm. long, stout, not filiform. Flower-buds dark pink-brown. Perianth 15 mm. long, 18 mm. across, slightly fragrant, the 3 outer lobes 9 by 3–4 mm., reaching 3–4 mm. beyond the tube, oblong, obtuse, recurved from about the middle and bent downwards, with 5 close, parallel nerves in the middle and with an indurated minutely hairy apex, lower surface pink-brown or greenish along the centre with the margin whitish, upper surface greenish or whitish or dirty-white, along the centre darker; the 3 inner perianth-lobes connate to about the middle, lower part oblong, 5 mm. long, tip 3–4 mm. long and as broad, recurved at right angle to tube, with an indurated apex which bears a few very minute hairs, lower surface whitish, along midnerve green or pink-brown, upper side white, or slightly tinged with green or pink-brown. Stamens attached to the perianth tube; filaments in their free part linear-lanceolate, flattened, 3 mm. long, white, bent twice at a right angle just below the anther. Anthers 2 mm. long, oblong, flat, thin, green, reaching the mouth of the tube, dehiscing longitudinally, introrsely. Ovary narrowly obovoid, trigonous, 5 mm. long, 2–2·5 mm. broad in the upper part, green,

stalk 1 mm. long. Style 5-6 mm. long, stout, slightly thickened at both ends, papillose, especially in the upper half. Stigma indistinctly 3-lobed, 1·5 mm. in diam., not thicker than the style. Young capsule much longer than broad.

Locality: In grass on Tableland of Panchgani, W. Ghats of Bombay Presidency, 4,400 ft. (Blatter No. P74, type).

Flowered about the middle of August 1925.

Dipcadi saxorum, Blatter, *sp. nov.* [Pertinens ad familiam Liliacearum accedit ad Dipcadi concanense, Baker, differet tamen ab ea specie scapo necnon racemo multo longioribus, racemo ca 20-floro, bracteis late ovatis et longe acuminatis basi laciniolatis, perianthio parvo, segmentis ovato-obtusis, staminum filamentis brevissimis, stylo multo breviore, seminibus paullisper ellipticis vel fere orbicularibus].

Bulb tunicate. Scape about 50 cm. long, terete, smooth. Racemes up to 20 cm. long, rather lax, about 20-flowered. Bracts broadly ovate, long-acuminate, scarious, slightly fringed near the base about 7 mm. long. Pedicels stout, by $\frac{1}{2}$ longer than the bracts. Perianth 12–14 mm. long, tubular, slightly trigonous, the 3 outer lobes connate for $\frac{1}{3}$ their length, linear-oblong, obtuse, recurved from about the middle with a thick, glandular tip, the 3 inner connate for almost $\frac{2}{3}$ their length, 3 mm. broad, ovate-obtuse, with a recurved and slightly thickened tip, all lobes whitish with an olive-coloured central band. Filaments about 1 mm. long, slightly flattened ; anthers 3 mm. long, versatile, yellow. Pistil 10 mm. long. Ovary 5 mm. long, trigonous, clavate, shortly but distinctly stipitate ; style very stout, 5 mm. long, minutely granular upwards ; stigma slightly thicker than style, 3-lobed. Capsule broader than long, deeply 3–sulcate, loculicidally 3-valved, membranous, stipitate, stalk stout, about 2·5 mm. long ; cells 5-seeded, seeds slightly elliptical to nearly orbicular in outline, reaching 5 mm. diam., compressed, with a raised margin, the lowest and topmost in each cell plano-convex.

Locality : Rocky places above the Kanheri Caves in Salsette, about 1,000 ft., Bombay Presidency (Blatter and Hallberg No. S1, type)

Flowered in August 1917.

BIRDS OF PREY AND THEIR USES

BY

C. H. DONALD, F.Z.S., M.B.O.U.

(*With 4 plates*)

From time immemorial the Raptores, as a class, have been looked upon as 'vermin' to be destroyed at sight. The gamekeeper has no use for them whatsoever, the poultry farmer (particularly in this country), wages continual war on them, and even the Memsahib, and her cook, chiefly the latter, have given of their best mutton-chops or beef 'i-stakes' to satisfy the hunger of some marauding kite.

In England, even the little kestrel is persecuted by the game-keeper as a destroyer of pheasant chicks and partridges, and in this country, as in parts of Ireland, 'the HAWK' is anathema to all who have anything to do with the preservation of game.

Yet, there is another side to the story, and if we go into the subject a little deeper than what appears on the surface, and consider the habits of the various species, one begins to wonder what we should do without them?

It, of course, must be thoroughly understood from the first that no bird of prey will ever refuse a good opportunity of taking an easy prey, such as a wounded or sick bird, or one in which the flight is defective from an injury to the wing or otherwise. A White-eyed Buzzard (*Butastur teesa*) who has spent his life catching rats, frogs and insects, will immediately bestir himself should a maimed partridge appear in the open within the range of his vision, whereas normally, a whole covey might feed with impunity in a field within fifty yards of his perch without his taking any notice of them or the partridges of him.

Let us now try and see to what extent the birds of prey, as a class, deserve this unenviable reputation.

From Mr. Stuart Baker's *Hand List of the Birds of India* we find there are 105 varieties of diurnal birds of prey. This represents almost one-sixth of the world's total number, so India is well supplied.

Of this number many are winter visitors which arrive in the autumn and disappear in the spring. Some are to be found in the hills and not in the plains, and *vice versa*, whereas many which are found in the north are wanting in the south, and southern birds are very often unknown in the north.

From this it is pretty evident that no hard-and-fast rule can be laid down for any particular locality, or even Province, and if we are to discover to what extent the Raptores are injurious to our

game preserves, we must first find out what species are normally found in that area.

To begin with let us make a list of the genera to be found in the whole of India, from which we must eliminate those which are harmless, and I have no doubt that many of our members will probably be surprised at the result.

The Order Accipitres is divided into three families, viz. Pandionidæ, Gypidæ and Falconidæ, the last being again subdivided into two sub-families, Gypaëtinæ and Falconinæ. It is unnecessary here to go into details regarding every species or variety, but we can enumerate the genera and state how many species each is comprised of, and these genera are :—

1. Pandion (Osprey), one ; Vultures (*Ægypius*, *Torgos*, *Gyps*, *Pseudogyps*, and *Neophron*) in all ten species : The Lammergeier (*Gypætus*), one ; True Eagles (*Aquila*), six ; Hawk-eagles (*Hieraëtus*, *Lophotriorchis*, *Ictinaëtus*, *Spizaëtus*), eleven ; Serpent Eagles, Buzzards, Fishing Eagles, Kites, Harriers, Honey-Buzzards, Bazas and Falconets, in all forty-five species and varieties, beginning with No. 1621 *Circaëtus gallicus* to No. 1654, *Buteo b. japonicus* ; No. 1670 to 1675 and again from 1692 to 1695.

This then leaves us with the hawks and falcons, i.e. *Astur*, *Accipiter* and *Falco*, which between them account for thirty-one species and subspecies.

Now out of this lot the following might safely be eliminated without further consideration as not coming within the range of game destroyers, viz. Osprey one, Vultures ten, the miscellaneous assortment from Serpent Eagles to Falconets forty-five, and the Lammergeier one.

That is fifty-seven species, or over one half of the birds of prey of India.

From this it must not be assumed that none of them ever catch a game bird, as harriers catch quail or even a very occasional partridge, and a fishing-eagle might often be seen flying off with a duck (though probably never one that has not been in some way maimed), but as a normal thing none of these birds are game killers and the majority are absolutely incapable of catching any game bird in full possession of its power of flight.

To this list we can add several others. The genus *Aquila* contains six species of big powerful birds, but of these six only one, the Golden Eagle (*A. c. daphanæ*) is a hunter, or capable of catching any game bird. The remaining five might safely join the list of the 'harmless'. The hawk-eagles must all remain in the list of suspects, and in fact are more or less, rather *more* than less all distinctly injurious, with the possible exception of *Hieraëtus pennatus* and *Ictinaëtus m. perniger*.

Among the hawks and falcons we have a number of keen hunters, but how many would normally take a bird as big as a partridge if smaller fry is available? Very few among the hawks, at any rate. From the falcons we can ignore the merlins, hobbies and kestrels as being too small to worry about, which leaves us with six falcons which are all capable of doing considerable damage.



BONELLI'S EAGLE
(*Hieraëtus fasciatus*)

Very destructive to game.



THE GOLDEN EAGLE
(*Aquila chrysaëtus daphanœ*)

Destructive to hill game in Autumn and Winter.



THE EASTERN GOSHAWK
(*Astur gentilis schvedowi*)

Very destructive in the hills.



THE LAGGAR FALCON
(*Falco jugger*)

Might become destructive in a particular locality.

This reduces the list to one eagle, nine hawk-eagles, six falcons and perhaps as many hawks, say a little over a score of birds in all, out of a total of 105.

Having arrived at the number that should be watched as probable destroyers, the next question for the game preserver to consider is how many of these ever visit, or are ever likely to visit his particular preserves. For this purpose we can divide them into two classes, those that will be found in the plains, and those that live in the higher ranges of the Himalayas. Of course, the list will vary with each province, but if for the sake of argument we take the Punjab, which I happen to know best, we should arrive at approximately the following conclusion. I say approximately because stragglers and wanderers might turn up anywhere.

Varieties	*Hills*		*Plains*
Golden Eagle	1		nil
Bonelli's Eagle	1		1 (up to 8000′)
Changeable Hawk-Eagle (rare)	nil	(low hills)	1
Hodgson's Hawk-Eagle	1		nil
Goshawk	1		nil
Shikras and Sparrow Hawks	5		5
Falcons	4		6
	13		13

The above then is a rough list of what might reasonably be expected to appear in either the hills or the plains of any district in the Punjab. It includes such birds as the Shanghar and Red-capped falcons, which are rare at best, whereas many species are restricted to particular tracts and are by no means universally met with throughout the Province.

This means, that in a province like the Punjab we need only bother about some thirteen species of the Raptores as being *likely* to destroy our game in any particular locality, and if each province was taken separately, the result would be more or less similar.

Having arrived at the above conclusion for the province, let us see how the thirteen birds effect our particular area, be it in the plains or in the hills, so let us start with a game preserve in the plains ; what do we find :—

(*a*) *Bonelli's Eagle.* They hunt in pairs and are undoubtedly destructive.

(*b*) *Booted Eagle.* Rare at best and will seldom take a bird as quick on the wing as a partridge.

(*c*) *Changeable Hawk-Eagle.* Only in the vicinity of low hills, but very destructive where found.

(*d*) *Shikras and Sparrow Hawks.* Not normally destructive to birds the size and strength of a partridge, but will take young chicks and cheepers.

(*e*) *Falcons.* If near water, the Siberian Peregrine will be a constant visitor in the winter, but partridges are only in danger when feeding far from cover.

(*f*) *The Indian Peregrine Falcon.* Not very common and birds only in danger when away from cover.

(*g*) *The Laggar Falcon.* Hunts in pairs and a pair may become attached to a preserve and do considerable damage when cheepers are about.

(*h*) *The Saker Falcon.* Is not likely to be found over scrub jungle, and prefers open plains and sandy tracts. Can be ignored.

(*i*) *The Red-capped and Shanghar Falcons.* Too rare to matter.

It will thus be seen that an intelligent interest in the doings of the Raptores which frequent any area is all that is necessary to find out the real culprits that are doing, or apt to do, damage but to call the whole family 'vermin' and try to exterminate them is the surest way of ruining any game preserve, as I shall endeavour to show.

Real enemies of ground game.

The next question is, when does ground game need most protection? Obviously in the nesting season.

During the nesting season what is its worst enemy? Here we have a number of things to contend with such as rats, mongooses, the larger snakes, monitor lizards, and to a smaller extent foxes, cats and perhaps jackals. Of these, again, which are the worst? Monitor lizards, rats (because of their numbers), snakes and mongooses. The last, however, might be allowed considerable latitude because of the good they do in keeping down snakes and rats. Snakes also eat rats, but the actual number of rats killed by snakes in the year must be, at best, comparatively small and almost negligible.

Any of the above-mentioned will wipe out an entire clutch of eggs in a few moments. It would take a hawk or a falcon, even if it took to a game diet and ate nothing else, a week or ten days to accomplish such a result.

On the other hand what keeps down rats and snakes, besides a mongoose, cats and foxes? The birds of prey. There is not a single bird of prey (except vultures), that will not catch and eat a rat, given the chance; not even the noble Peregrine or the mighty Golden Eagle, will refuse the tit-bit, whereas the majority of them practically live on them. Remove this host from any area and the result will probably spell disaster.

I have recently been through the best partridge preserves in the province, during the gun dog trials in Patiala and Jind, and the fact was very noticeable that we came upon patch of jungle where the birds were extremely plentiful, in fact too plentiful for the peace of mind of the working dogs, whereas we also came upon patches where for half an hour at a time, not a bird was flushed. This fact led me to keep an eye on the nature of the ground and I noticed that many of these barren beats were infested with rat holes, and the mounds of the mole-rat were much in evidence. Was this a coincidence, or does it bear out my theory that rats are one of the biggest enemies that ground game has?

Throughout the six days, four in Jind and two in Patiala, that I was there, I also kept a close eye on the birds of prey we encountered, and these are the species I saw:—Shikras, in plenty. One chased a partridge that had been very slightly wounded for



THE EASTERN STEPPE-EAGLE
(*Aquila nipalensis nipalensis*)

An excellent rat killer



THE BOOTED EAGLE
(*Hieraëtus pennatus*)

More friend than foe.



THE KESTREL
(*Falco tinnunculus*)

Lives on rats, mice and insects; very occasionally kills a bird.



THE WHITE-EYED BUZZARD
(*Butastur teesa*)

A ratter pure and simple.

quite a long way, but failed to catch it. I never saw another one attempt to chase, though I twice saw partridges fly into the open and pass a tree, into which a shikra had gone a few minutes before, without the latter taking any notice. One pair of Red-headed Merlins, two pairs of Laggar Falcons, several White-eyed Buzzards, a couple of Long-legged Buzzards, and a larger number of Tawny and Steppe Eagles, and one Imperial Eagle. A Steppe Eagle carried off a partridge that had been shot and was, in turn, pursued by no less than four others and an Imperial, but which eventually got the booty I did not discover. I noticed harriers on several occasions, and a very fine adult Spotted Eagle took up a commanding position over the water on which the water test took place, but 'moved on' as soon as the first shot was fired. I saw no sign of any of the 'nobler' falcons and was somewhat surprised not to see a single Bonelli's Eagle.

The presence of eagles and buzzards is a fairly good indication that rats are numerous and hunting (of rats) good.

In the hills, what is the worst enemy game birds have to contend with in the breeding season? The Jungle Crow first and foremost, and the Indian Marten. Then possibly foxes, cats and such like. During the autumn and winter the Golden Eagle takes considerable toll, and the Hodgson's Hawk-Eagle and the Goshawk at all times, but the Goshawk is by no means as common as it used to be, and the Hodgson's Hawk-Eagle is curiously given to certain localities and completely wanting in others. It is very common, for instance, in Bhadarwar and parts of Chamba and very rare in Kangra. Yet it is very common again in parts of the Simla Hills such as the Jubal and Taroach States, but rare on the Sutlej watershed. This species is particularly destructive to pheasants of all kinds and his method of hunting does not give them the smallest chance of escape.

The Golden Eagle, on the other hand, does not appear to touch game during the breeding season and every nest I have examined (and I have taken four youngsters from their nests, as far apart as one in Kashmir, two in Bushahr State (Simla Hills) and one in Tehri Garhwal), has contained more remains of crows than anything else.

The reason for this is not hard to seek. He is a typical falcon in his way of hunting, and prefers the open. His long wings are all against his hunting among trees, and unless pheasants can be flushed for him and rise above the trees, he is powerless. During the summer months most pheasants keep to thick cover, except Snow-cock and a few Monal which go out on to the Alpine pastures to feed. At this period the Golden Eagle has his work cut out providing food for a shrieking youngster in the nest, and it is not quality he seeks but quantity, and there is no lack of crows.

Crows, with dozens of youngsters, go in large flocks to roost among the oaks at high levels in the evening and come down in the morning, and the eagle has no difficulty in getting as many as he wants. In this respect he does a great deal of good, but there is no denying the fact that any and every pheasant which has the temerity to feed out in the open, in the autumn when the young eagle accompanies its parents, is looking for trouble.

Bonelli's Eagle, though unlike the other hawk-eagles in his method of hunting, does considerable damage, particularly among Chukor. They always hunt in pairs and are very persistent in their attack.

Though we have already reduced the possible destroyers of game to thirteen, it must be remembered that this number is the maximum of what might reasonably be expected to be seen over any particular locality, and it can be very considerably reduced for really practical purposes. For instance, in the plains, the possibility of five species of shikras and sparrow-hawks appearing in any one locality is very remote. Then again, during the most important period of game preservation, viz. the breeding season, at most two species of falcons will be found, the rest having left the country.

Thus the game preserver need only trouble himself with a very small percentage of the total number, and then only if he finds that some particular individuals have regularly attached themselves to the vicinity and taken to a game diet. Rather than shoot the wrong birds it would perhaps be better to shoot none at all.

After all if we look at it in another way we find that the commonest hawk in the plains of India, and the hills too for that matter, is perhaps the Shikra. It takes considerable toll of the smaller birds, and so do Red-headed Merlins, and yet do we find any diminution in babblers, sparrows and our host of little garden birds ?

Most of us can probably name various places where game was plentiful twenty or thirty years ago, inspite of the birds of prey, which had been there with the game from time immemorial. I can even now find my way to places in the Himalayas where Monal and all the other pheasants are extremely numerous, and appear to thrive inspite of the presence of Golden Eagles, Goshawks and the other birds of prey. But these are places where there is not a village within twenty miles and the people in those villages have not yet aspired to gun licenses.

It is man, with his guns, nets and nooses who does most of the damage. Before he came on the scene as a destructive agent, Nature preserved her balance. Now since man has upset the balance it behoves him to remedy the evil that he has brought about, if we would preserve our game, and to do that it is necessary to consider the whole position intelligently, and discover the real agents of destruction and wage war on them, and not seek to destroy an entire family simply because one member has proved a game-destroyer.

Is it not time that the Society took up the question of not only game preservation but the preservation of our fauna generally ? India is dependent on its agriculture, and the thousands of birds, of which the zamindar knows nothing and cares less, are one of the main factors which protect his crops. Out of over 2,000 odd species to be found in the Indian Empire, a good sixty per centum are insectivorous and therefore the zamindar's staunch allies. There are only a very small percentage that are actively destructive. Under the Arms Act we have numbers of would-be shikaries who are out to shoot something for the sake of shooting, in season and out of season.

Under the Wild Birds and Animals Protection Act, Government can stop the shooting of any particular species, but cannot declare a general close season. Is this of any use? You cannot do anything to a man unless you actually catch him in the act of shooting a protected bird, and what is to prevent him shooting a dozen protected birds when no one is near, and producing an 'unprotected' bird when questioned ?.

A general close season when the carrying of a shot gun is an offence under the Act is essential, except in the vicinity of crops. Crop protection licenses might be issued free of charge, but the moment the man is found using his gun outside his crops the license should be cancelled and the arm forfeited.

Something on these lines will have a very beneficial effect but the present system spells extermination of game within the next two decades or so.

The rules and regulations of the Forest Acts can only apply to protected forests, but what about the rest of the country where the 'would-be' shikari, to say nothing of the many criminal tribes with their nets and nooses, can destroy what they like with impunity ?

A NOTE ON THE BIRDS OF THE PESHAWAR DISTRICT

BY

REV. F. S. BRIGGS AND B. B. OSMASTON, M.B.O.U., I.F.S. (RETD.)

(*With a map.*)

The following notes on the birds of the Peshawar District have been combined from the observations of the Rev. F. S. Briggs and Mr. B. B. Osmaston by Mr. Hugh Whistler. The former spent six years at Peshawar, from 1920 to 1926. The latter was there merely for a single cold weather from October 27, 1925 to March 27, 1926, but the shortness of his stay was compensated for by the care with which he made a collection of skins to identify the cold weather avifauna. These skins have been enumerated under their respective species, and the identification of the various racial forms is largely due to them. It is, however, realized that this list of Peshawar birds cannot be considered complete. It is proffered both as a record of the notes made by these two observers, and as a groundwork for a fuller investigation of the avifauna of what, from its position, will undoubtedly prove to be one of the most interesting and prolific districts of India to the students of the palæarctic area.

Peshawar is situated in the north-west corner of British India, N. Lat. 34°, E. Long. 71½°, in a wide plain traversed by the Kabul River, and surrounded by hills.

This valley or plain measures some forty-eight miles from east to west, and about thirty from north to south. It is roughly level, at an altitude of about 1,100 feet above the sea.

For six or seven miles in all directions from Peshawar the valley is very fertile owing to a very complete system of irrigation by canals from the Kabul and Bara Rivers, and magnificent crops of wheat, barley, maize, rice and sugar-cane are produced.

Outside the irrigated area the country is virtually a desert, owing to the shortness of the rainfall, Peshawar being outside the area served by the South-west Monsoon.

These dry desert areas bear little or nothing in the way of trees, vegetation being restricted to a sparse growth of thorny shrubs. Woods and tree-growth are restricted to the irrigated tract, including Peshawar Cantonment, which is well wooded with a variety of trees. Elsewhere in the irrigated tract we find extensive orchards of pears, quinces, peaches, oranges and pomegranates, and along streams willows and mulberries, with roadside avenues of tamarisk and sheesham.

The climate is one of extremes. The winter months, from October to March, are cold, with regular night frosts from December to February, but with plenty of warm sunshine in the day. The summer heat is severe and prolonged, and frequently the temperatures registered at Peshawar are as high as, or even higher than those in any other part of India.

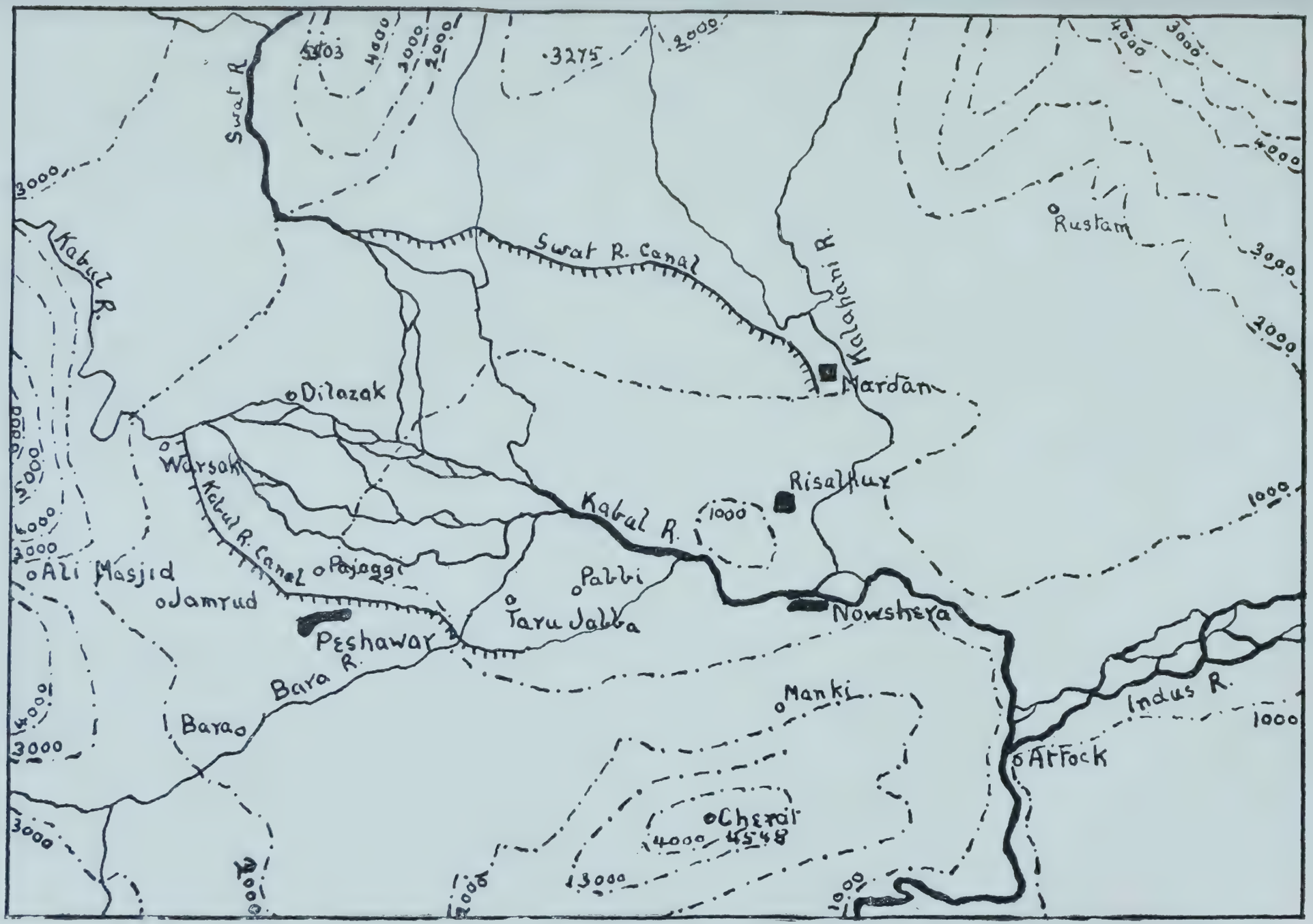
The country round Peshawar falls naturally into three classes :—

1. The irrigated tract, including Peshawar itself and its immediate surroundings, characterized by field crops and a considerable quantity of tree growth.

2. The dry, desert country, surrounding the first, and extending to the hills.

3. The swamp areas, found scattered in (1), and also including very large beds of bulrushes, reeds and tall grass in the neighbourhood of the Kabul River and its branches and backwaters. Unfortunately, from the point of view of the ornithologist, a very large proportion of the reeds are cut and dried for fuel and other purposes just at the time when they would provide nesting-sites for several species of birds.

The birds which affect these three types of country are mostly quite distinct.



Scale 1 inch = 12 Miles or $\frac{1}{3,760,320}$

Rivers ; Canals Contours 1000

Journ. Bombay Nat. Hist. Soc.

1. Corvus corax (L). The Raven.

Although rarely seen in Peshawar itself the Raven is found in winter throughout the Peshawar Valley, being common a few miles out, for instance in the more open stretches round Nowshera and Risalpur, near Jamrud, and along the Khaibar Pass and Kohat Roads. During the hot weather it is only to be seen in the valley on occasional cool days following rain, but it is at this season very numerous at Cherat, and a few may be seen in the Khaibar Pass. A pair build regularly on the cliffs on the Marble Rocks, between Nowshera and Risalpur. The nest contained four newly hatched young and two infertile eggs on March 6,1923, and three fresh eggs on February 8,1925. The birds which laid in this nest were certainly *C. c. laurencii*, but some of the Ravens seen in the valley and more especially in the Khaibar Pass are very rusty in appearance, and it is possible that *C. c. ruficollis* either breeds in the Pass, or wanders into the valley. No specimens were, however, procured.

2. Corvus coronoides intermedius (Adams). The Himalayan Jungle Crow.

♂ January 2, 1926, ♂ February 7, 1926, Peshawar. A single bird was shot by Osmaston at Peshawar on February 7, feeding on the carcase of a buffalo. There is some doubt as to whether it is this species or the Carrion Crow (*Corvus corone*) which Briggs noticed as a regular but never numerous winter visitor to the Peshawar Valley. He records it as always commoner in March and April than at any other time, and then apparently migrating in a westerly direction as small parties may be seen making their way up the Khaibar Pass.

3. Corvus frugilegus (L). The Rook.

♂ ♀ February 5, 1926, Peshawar. Abundant winter visitor, arriving towards the end of October (earliest date October 23), and gradually becoming more numerous ; practically all are gone by the end of March ; latest date observed April 5. During the daytime the Rooks feed in the irrigated fields, and are then rarely seen in Cantonments or villages. They collect, however, in vast flocks at night to roost in the avenue trees in the Cantonments of Peshawar and Mardan, though none seem to sleep in Nowshera or Risalpur.

4. Corvus cornix sharpii. (Oates). The Eastern Hooded Crow.

♂ December 21, 1926, ♀ January 21, 1926. Peshawar ; ♂ December 29, 1925, Pabbi. A regular winter visitor ; earliest date October 23, latest date March 23. It is found in pairs, or rarely in small parties, often associated with Rooks, and keeps almost entirely to the wilder, more open, and barren parts of the valley specially in the vicinity of swamps or the river. It is the wildest and most wary of all the local crows.

5. Corvus splendens zugmayeri (Laubm.) The Sind House-Crow.

♂ December 29, 1925, Peshawar. Exceedingly common and resident in and around Peshawar. It roosts separately from the Rooks. Eggs are mostly laid in the first week of July. In February, 1921 there appeared to be an epidemic among the species, and considerable numbers fell dead from their sleeping-perches.

6. Corvus monedula sœmmeringii (Fischer). The Eastern Jackdaw.

♀ February 5, 1926, Peshawar. A winter visitor from November to early March, varying in numbers greatly from year to year. In the winter of 1920–21 they were numerous, and very numerous again in the winter of 1925–26, whereas in the winter of 1921–22 Briggs only saw them once, namely on January 1. They feed in the fields with the Rooks, and also roost with them.

7. Nucifraga multipunctata (Gould). The Larger Spotted Nutcracker.

A straggler, probably of this species, which is the form found on the Sufed Koh to the west and in Hazara to the north, was seen by Briggs in Peshawar on April 23, 1920. The previous night had been very stormy.

8. Parus major kaschmiriensis (Hartert). The Kashmir Grey Tit.

♀ October 31, 1925. ♀ November 6, 1925, Peshawar. A fairly common winter visitor to the Peshawar Valley ; earliest date October 21, latest date March 30. It keeps chiefly to the wooded areas.

9. Parus monticolus (Vigors). The Green-backed Tit.

A winter visitor, less numerous than the last species. Earliest date October 13, latest date March 14.

10. Ægithaliscus concinnus (Gould). The Red-headed Tit.
A party of about six were seen by Briggs at Cherat about 4,500 on August 22, 1920.

11. Argya earlii (Blyth). The Striated Babbler,
Rather rare, but probably a resident. A nest with fresh eggs was taken by Briggs in swampy ground at Rashkai near Mardan, on May 29, 1922.

12. Argya caudata. The Common Babbler.
♂ ♀ November 16, 1925. ♂ ♀ November 18, 1925. ♂ December 14, 1925, Peshawar.
A common resident, numerous in the long grass and tamarisk near streams, and, as elsewhere, found in loose parties. In winter it is more numerous in gardens than in summer. While breeding it shows a preference for evergreens. Fresh eggs found between March 21 and August 19 but mainly in April.

13. Molpastes hæmorrhous intermedius (Jerdon). The Punjab Red-vented Bulbul.
♂ ♀ November 16, 1925. Common in Peshawar and in the surrounding woods. Doubtless resident, but Briggs notes :—'In the unusually dry and hot summer of 1920, Red-vented Bulbuls became scarce about the middle of July and remained so till the evening of September 29. On that evening, about seven o'clock, a large flock of white termites appeared in Peshawar, with numbers of Bulbuls in pursuit of them. For about twenty minutes not less than thirty Bulbuls were busily employed in my garden feeding on the termites which they caught in the air after the manner of Flycatchers. The next day Bulbuls seemed to be about the same numbers as they had been the previous winter, and I noticed no great fluctuation in numbers afterwards.' Fresh eggs found between March 13 and July 12.

14. Molpastes leucogenys leucogenys (Gray). The White-cheeked Bulbul.
♂ ♂ November 13, 1925. ♀ November 18, 1925. ♂ December 7, 1925. ♂ December 13, 1925.

15. Molpastes leucogenys humii (Oates). Hume's White-eared Bulbul.
♂ ♀ ♀ January 11, 1926. Twenty miles south-east of Peshawar.
Osmaston collected a nice series of ten of these Bulbuls in the winter of 1925–26, and states that they are common, and found to some extent in the dry tracts, though mainly in the irrigated area. He suspects that they may be a winter visitor. Briggs' longer observations enable him to amplify this as follows :—'Very numerous in winter, especially in the latter part. In the summer this bird retires from the lower parts of the valley to the hills surrounding it. I have found them breeding at Attock at about 1,000 feet, below Cherat at about 2,000 feet and near Ali Musjid at about 2,500 feet. It is surprising that the White-cheeked Bulbul of the Peshawar Valley should be *leucogenys* and not *humii*.' He further adds that he saw two Bulbuls outside Peshawar on the Jamrud road on January 18, 1920, which he identified as *M. l. loucotis*.
An examination of Osmaston's series shows that all the specimens from Peshawar are clearly *M. l. leucogenys*, and we are justified in describing that form as a regular and common winter visitor to Peshawar. Three birds, however, obtained in the dry foot-hills 20 miles to the south-east of Peshawar are closer to *M. l. humii*, and doubtless represent the resident form. We have been compelled for the identification of these birds to examine the British Museum series as well as thirty birds in Mr. Whistler's collection, as the account of these forms in the second edition of the Fauna is not very satisfactory, and superficially they are difficult to understand owing to the amount of variation in the individual. It may be as well, therefore, to explain the position.
The Yellow-vented Bulbuls of North-west India form an excellent example of a species, divided into subspecies, and connected by intermediate forms. Gray in 1830 described the hill bird from Darjeeling and in this species, curiously enough, although the bird is so variable in the north-west generally, birds from the Eastern Himalayas are precisely similar to birds from the Western Himalayas as *leucogenys*, while Gould in 1836 described the plains bird as *leucotis*; its type locality has since been restricted to Karachi, Sind.

If Sind and Himalayan birds alone are contrasted, we have two very distinct birds, which might well rank as full species, with no danger of confusion between them.

Leucogenys is a large bird with a long, comparatively slender bill, compared with the smaller *leucotis* and its short bill.

Leucogenys : Bill from skull ♂ 18–20 mm. ; ♀ 17·5–19·5.
Wing ♂ 88·5–98 ; ♀ 88–96·5
Leucotis. Bill from skull ♂ 17 mm. ; ♀ 16·5–17 :
Wing ♂87–88 ; ♀ 81·5–85

In *leucogenys* the crest is so long and so curved forward over the beak that it resembles a fool's cap in shape—a peculiarity most marked in life ; the colour is hair brown, each feather being narrowly edged with greyish white. There is a white line above the lores. The upper plumage is earth-brown tinged with olive-brown and even olive green. The under tail coverts are bright sulphur yellow.

In *leucotis* the crest is so short as to be almost non-existent ; it is entirely black, and there is no white line above the lores. The white cheek-patch is twice as large as in the other bird, and the black on the throat is more sharply defined, contrasting with the whitish lower plumage. The upper plumage is plain fawn brown. The under tail coverts are rich saffron yellow.

But between these forms a regular gradation may be found in the triangle of country which extends north-west of the Salt Range to the Afghan ranges and to the Himalayas. The elevation here runs between 1,000 and 3,000 feet and the Bulbuls from this area approximate more closely to *leucogenys* than to *leucotis*, in that all have the under tail coverts bright sulphur yellow, and in their size. The crest and loral line are variable, as is also the colour of the upper parts.

It so chances that in 1889 Oates picked out a single bird from this intermediate area, from Jalalpur, Jhelum District, on the southern border of the triangle, and made it the type of his *Molpastes humii*, so this name is available for the intermediate forms. It must be remembered, however, that this race *M. l. humii* being a true ' intermediate is variable, approximating on either side to the two races which it connects. This approximation follows fairly definite lines. Birds from the Jhelum Salt Range agree fairly closely with Oates ' type, which in its shorter black crest without pale edging and with practically no trace of the white loral line, in the size of the white cheek-patch, and in the fawn coloured upper plumage, is very close to true *leucotis*. Birds from Kohat and Bannu are in turn closer to *humii* as are Osmaston's three birds from the dry foothills about Peshawar. At Attock, Campbellpur, and Rawalpindi, however, we find, as might be expected, that the birds are much closer to the true *leucogenys*, which also probably in winter descends from the Himalayas and mixes with them. Indeed they are as close to *leucogenys* as Oates' type is to *leucotis*, and a determined ' splitter ' might name them so as to make two groups of races merging into one another.

This explains the situation at Peshawar. The resident bird belongs to the drier areas and low ranges, and is of the intermediate race *humii* ; it is, however, obscured in winter by a regular immigration to the fertile irrigated area of the Himalayan race, *leucogenys*.

16. Certhia himalayana (L). The Tree-Creeper.

♀ November 20, 1925. ♀ November 24, 1925, Peshawar. A fairly common winter visitor, found in avenues, woods, and gardens. Earliest date seen October 17, 1925, latest date March 14, 1925. Briggs found one caught in a spider's web and entirely unable to free itself.

17. Tichodroma muraria (L) The Wall-Creeper.

A numerous winter visitor to the sandy nullahs and rocky gorges that surround the Peshawar Valley, such as the Khaibar at Ali Musjid, Attock and the Kalapani River at Risalpur. Peshawar itself is not suitable to its requirements.

18. Saxicola caprata bicolor (Sykes). The Pied Bush-Chat.

♂ December 30, 1925, Peshawar. Mainly a summer visitor, though a few birds winter in the valley. The earliest and latest dates for the mass are February 28 and October 1. In the valley eggs may be found commonly between April 7 and May 17, but Briggs found two nests with eggs on the point of hatching on July 11, 1922. The majority of the birds of this species appear, after breeding

in the valley, to take their young, as soon as they can fly, to the lower hills round the Peshawar Valley.

19. Saxicola torquata indica. (Blyth). The Indian Stone-chat.
♀ November 9, 1925, ♀ November 20, 1925, ♂ November 26, 1925, Peshawar. Mainly a spring and passage migrant, noted by Briggs as passing in spring between March 17 and May 24, and in autumn between September 24 and October 10. A few however, remain in winter.

20. Saxicola torquata leucura (Blyth). The White-tailed Stone-chat.
♂ December 12, 1925, Peshawar. Osmaston collected a pair at Peshawar on December 9, 1925, and his statement that a Stone-chat is not uncommon throughout the winter, especially in grassy areas near swamps probably refers partly to this race.

21. Œnanthe picata (Blyth). The Pied Wheatear.
According to Briggs a regular winter visitor to the Valley, keeping mainly to barren country : earliest and latest dates seen are September 8 and March 8. It breeds in the Khaibar Pass, where Briggs on several occasions saw it carrying nesting material, but never had the opportunity of examining a nest.

22. Œnanthe capistrata (Gould). The White-headed Wheatear.
♂ November 15, 1925, ♂ December 6, 1925. According to Briggs, breeds in all the hills round the Peshawar Valley down to about 2,000 ft. A pair were watched at work on a nest in the Manki Pass, a few miles S. of Nowshera, on March 21, 1923. The nest was then almost complete. It is much commoner as a winter visitor to the Peshawar Valley than the last species. Briggs notes that ' Individuals of this species seem to be much attached to limited localities in their winter area. For example, on the road between Nowshera and Risalpur I could be certain of seeing four birds of this species any day in the cold weather. Near a lime kiln there was always a pair of them, male and female, and within fifty yards of a certain tree there was always a single male. There was always another single male in the compound of the house at Risalpur where I usually stayed. I always looked for him on the telegraph wires outside the house on my arrival, and nearly always saw him there.' Briggs' earliest date for the species is September 18. He, like other observers in other areas, remarks on the preponderance of males in winter both in *Œ. picata* and *Œ. capistrata*.

23. Œnanthe opistholeuca (Strickland). Strickland's Wheatear.
♂ December 21, 1925, ♂ December 11, 1925. Not recorded by Briggs, but said by Osmaston to occur in the dry country in winter, though not so commonly as the last species.

24. Œnanthe isabellina (Cretsz). The Isabelline Wheatear.
♀ November 15, 1925, Peshawar. ♂ January 25, 1926, Risalpur. Fairly common locally in winter, generally in the neighbourhood of cultivation, in the dry, desert land at the foot of the hills.

25. Œnanthe xanthoprymna chrysopygia (De Filippi). The Red-tailed Wheatear.
♀♀ December 17, 1925, Bara Fort, five miles south-west of Peshawar. Fairly common in the Khaibar, and probably breeds there. In the winter it is not rare in the dry, desert country below the foothills.
It is noteworthy that neither Osmaston nor Briggs record the desert Wheater, *Œ. deserti*, which is so common a winter visitor to the Punjab.

26. Phœnicurus erythronotus (Evesrm.) Eversman's Redstart.
♂ January 22, 1926, Dilazak, ♀ December 7, 1925, ♀ December 10, 1925, Peshawar. Stated by Osmaston to be seen occasionally throughout the winter in the irrigated area.

27. Phœnicurus ochrurus phœnicuroides (Moore). The Kashmir Redstart.
A common winter visitor, but for some reason less numerous than usual in the winters of 1924-25 and 1925-26. Earliest date seen September 24, latest date April 17. It occurs both in the wet and dry areas, but, according to Briggs, shows a strong preference for the neighbourhood of Tamarisk trees.

28. Chaimarrhornis leucocephala (Vigors). The White-capped Redstart.
One was seen by Briggs in the Khaibar Pass on December 12, 1924.

29. Rhyacornis fuliginosa (Vigors). The Plumbeous Redstart.
Recorded by Briggs as fairly common on the Khaibar Stream during the cold weather.

30. Cyanosylvia suecica pallidogularis (Sarudny). The Eastern Red-spotted Bluethroat.
♂ October 31, 1925, ♂ November 18, 1925, ♂♂ November 28, 1925, ♂ December 6, 1925, Peshawar. ♂ January 22, 1926, ♀ December 29, 1925, Pabbi. Very numerous on passage, passing through the valley between April 10 and May 10, in spring, and between September 14 and October 14 in autumn. During the spring migration they seem to pass through almost entirely in pairs, and may frequently be seen courting. In autumn they are less numerous, and seem as a rule to make a shorter stay. In the winter they are not uncommon in the irrigated country in dense cover such as sugar-cane, and grass and bulrushes especially near swamps.

31. Saxicoloides fulicata cambaiensis (Lath.). The Indian Robin.
♂ November 15, 1925, Peshawar. A resident, but more numerous in summer than in winter. In this area (as at Kohat), it avoids the neighbourhood of houses, and prefers barren country, especially the stony Mahomedan graveyards. Eggs found by Briggs between April 18 and May 24.

32. Turdus atrogularis (Temm.). The Black-throated Thrush.
♂ November 10, 1925, ♂ December 3, 1925, ♂♀ December 8, 1925, Peshawar. A very common winter visitor, found chiefly in and around the station area and in orchards. It is most numerous in February, and the latest date on which it is recorded is March 28.

33. Turdus viscivorus (L). The Missel Thrush.
One was seen by Briggs at Peshawar on February 2, 1921.

34. Oreocincla dauma (Lath.). The Small-billed Mountain Thrush.
One was noted by Briggs on February 9, 1924.

35. Monticola solitaria pandoo (Sykes). The Blue Rock Thrush.
Not found in Peshawar according to Osmaston, but observed in the neighbouring rocky hills, Khaibar, etc.

36. Myiophoneus temminckii (Vigors). The Himalayan Whistling Thrush.
Not found in Peshawar according to Osmaston, but seen on the streams in the neighbouring foothills.

37. Prunella atrogularis (Brandt). The Black-throated Accentor.
♂ January 1, 1926, Peshawar. Not uncommon, according to Osmaston, in January and February in Pirbala and other woods..

38. Musicapa striata neumanni (Poche). The Spotted Flycatcher.
Briggs records that he saw a flock of these Flycatchers (and was certain that they were not *Alseonax latirostris*) feeding in his compound at Peshawar on April 19, 1921, and again from October 6 to 16, 1921, and on April 4, 1922.

39. Musicapa hypoleuca (Pallas). The Pied Flycatcher.
Briggs writes :—'A few birds indistinguishable from the British species pass through Peshawar almost every spring. Earliest and latest dates seen February 18 and March 30. The only year that I have seen the species in the autumn was 1925, when a pair fed in my compound almost every day from October 31, till I left Peshawar on January 11.' The species has not yet been included in the Indian list, so future observers at Peshawar should make every effort to verify this occurrence by obtaining specimens. The species does not appear to have been recorded nearer than Tehran.[1]

40. Siphia parva parva (Bechst.). The Red-breasted Flycatcher.
♂ October 29, 1925, ♂ November 8, 1925, ♀ December 1, 1925, Peshawar. Chiefly a passage migrant, the majority passing through in spring between March 24 and April 21. First noted on the autumn migration on October 21. After the first rush their numbers gradually decrease until only a few remain for the

[1] *J.B.N.H.S.*, vol. xxvii, p. 114.

winter. They are found in the orchards and station area, and along all roads bordered with Tamarisks. Red-breasted males are very rare amongst the winter birds.

41. Culicicapa ceylonensis. The Grey-headed Flycatcher.
♀ November 7, 1925, Peshawar. The above specimen was obtained by Osmaston.

42. Terpsiphone paradisi (L.). The Paradise Flycatcher.
A few breed in the valley, as Briggs found a female feeding three young in the trees overhanging the Grand Trunk Road, eight miles east of Peshawar on June 20, 1923. It is, however, a passage migrant in spring and autumn. Briggs states that they pass through in large numbers, but appear to stop only one day. That day falls, as far as his observations go, between April 23 and 29, in the spring, and between September 19 and 29, in the autumn. The race has not been identified.

43. Lanius excubitor lahtora (Sykes). The Indian Grey Shrike.
o ? January 13, 1926. Not common, but appears to be resident. It is confined to barren stretches of country near the foot of the hills, showing a preference for ground studded with stunted Ber trees.

44. Lanius vittatus (Valenc.). The Bay-backed Shrike.
A summer visitor, very common in cultivated ground. Earliest date seen March 23, latest date September 19. It has two broods, building a fresh nest for each. Eggs found between April 7 and July 7. Stragglers were seen by Briggs near Taru Jabba on February 20, 1923 and January 25, 1924.

45. Lanius schach erythronotus (Vigors). The Rufous-backed Shrike.
♂ November 13, 1925, Peshawar. Resident, but much more common in summer than in winter and a bird of the irrigated tract. A male of this species was observed by Briggs to feed in his garden almost daily for the whole of the six years he was in Peshawar. For the greater part of the year this bird was alone, but, in the spring he was joined by a female, generally about the middle of March. Each year they built either in his garden or the one next to it, and usually succeeded in bringing off two broods of young. Once or twice they used the same nest for both broods. The young of the first brood always disappeared before the second brood had left the nest, and as soon as the second brood was able to fly at all strongly, generally some time in August, they and the hen disappeared. It is, of course, unsafe to generalize from a single case of this sort, but it might be worth while to shoot a few Rufous-backed Shrikes in winter with a view to discovering whether the decrease in their numbers each winter is due to the migration of the females. It is to be noted that the one specimen obtained by Osmaston, in November, was a male.
Osmaston remarks that the bird is a wonderful mimic ; he heard it giving in quick succession an accurate imitation of the notes of the following :—House Sparrow, Swallow, Indian Swift, Parrakeet, Mynah, Sandpiper, Bulbul and Common Babbler. Eggs found between April 10 and July 1.

46. Lanius cristatus isabellinus (Hemp. and Ehr.). The Isabelline Shrike.
♂ November 30, 1925, ♂ January 26, 1926, Peshawar. The above two examples, procured by Osmaston, are the only records.

47. Tephrodornis pondiceriana (Gmel.). The Common Woodshrike.
One was seen by Briggs on the outskirts of Peshawar on March 7, 1921.

48. Pericrocotus brevirostris brevirostris (Vigors). The Short-billed Minivet.
♀ November 10, 1925, ♂ December 1, 1925, Peshawar. An erratic winter visitor, appearing for a day or two at a time in small flocks, never more than ten strong.

49. Dicrurus macrocercus (Vieill.). The King Crow.
A common summer visitor, laying in the first half of May. Earliest date seen March 22, latest date October 1.

50. Dicrurus leucocephalus longicaudatus (A. Hay). The Ashy Drongo.
A pair was seen by Briggs in the Khaibar, May 28, 1925.

51. Acrocephalus stentoreus brunnescens (Jerdon). The Indian Great Reed Warbler.

♂ November 5, 1925. The above specimen shot by Osmaston was alone in a swamp. He did not meet the species again till March 15, when he saw and heard others, doubtless on migration.

52. Lusciniola melanopogon mimica (Madrasz). The Moustached Sedge Warbler.

♂ November 5, 1925, o ? January 22, 1926, Peshawar, ♀ December 29, 1925, Pabbi. Obtained by Osmaston, who found it common and noisy, though difficult to observe in the swamps, especially in borrow-pits by the railway.

53. Cisticola juncidis cursitans (Frankl.). The Fantail Warbler.

♂ November 12, 1925, ♀ December 4, 1925, Peshawar. Found by Osmaston in some of the grassy swamps, but stated to be not very common.

54. Franklinia buchanani (Blyth). The Rufous-fronted Wren Warbler.

♀ November 15, 1925, Peshawar. The above specimen obtained by Osmaston in the dry country supplies the only record.

55. Sylvia curruca affinis (Blyth). The Indian Lesser Whitethroat.

♂ November 5, 1925, ♀ November 6, 1925, ♂ December 11, 1925, Peshawar. A fairly common winter visitor.

56. Sylvia curruca minula (Hume). The Small Whitethroat.

♂ December 11, 1925, Peshawar. The above specimen was obtained by Osmaston.

Briggs reports that individuals of one or other of the above races of *S. curruca* spend the summer in the Tamarisk scrub on the banks of the Kalapani River. Presumably they are non-breeders.

57. Phylloscopus collybita tristis (Blyth). The Siberian Chiff-chaff.

♂ October 29, 1925, ♀ November 3, 1925, ♂ November 8, 1925, ♀ December 11, 1925, Peshawar. A very common winter visitor, especially in the wet country. It is to be found in every clump of trees, also in road-avenues of Shisham and Tamarisk, and often feeding by streams. The song may be heard in April before the birds leave for their summer quarters.

58. Phylloscopus subviridis (Brooks). Brooks' Willow Warbler.

♂ November 11, 1925, Peshawar. A winter visitor, and probably not uncommon.

59. Scotocerca inquieta striata (Brooks). The Streaked Scrub Warbler.

A resident and fairly numerous on the dry, rocky hill sides on the spur which separates Kohat from Peshawar, also on dry ground in the vicinity of Risalpur. Osmaston found a nest with six eggs in the former place on March 12, 1926, and Briggs found a nest containing one young bird on the point of leaving the nest near Risalpur on April 15, 1925.

60. Horornis pallidus (Brooks). The Pale Bush Warbler.

Observed by Osmaston towards the end of February in the Pirbala woods, its note being quite unmistakeable.

61. Cettia cetti cettioides (Hume). The Eastern Cetti's Warbler.

♂ October 31, 1925, ♂ November 23, 1925, ♂ January 9, 1926, ♂ January 12, 1926, ♂ January 25, 1926, ♂ January 26, 1926, Peshawar. Fairly common, and widely distributed in every swampy patch, provided there is ample cover of bulrushes, reeds, or long grass. They are rarely seen, being extremely shy and careful not to expose themselves. Their presence is, however, revealed by a rather loud 'click' repeated at intervals from dense cover. The above series was only obtained by the exercise of much patience and preseverance

62. Prinia gracilis lepida (Blyth). The Streaked Wren Warbler.

♀ November 26, 1925, ♂♀ November 30, 1925, Peshawar, ♂ January 28, 1926, Risalpur. Generally distributed in and around grassy swamps as well as in cultivated fields.

63. Prinia inornata inornata (Sykes). The Indian Wren Warbler.
♀ November 5, 1925, ♀ November 10, 1925, ♀ November 11, 1925, ♂ ♀ November 16, 1925, ♂ November 26, 1925, ♂ December 26, 1925. A common bird in long grass in moist localities, occurring in the winter in small parties.

64. Oriolus oriolus kundoo (Sykes). The Indian Oriole.
Status uncertain. Briggs says :—' Common in April and May. A few pairs may breed in the valley. One young bird seen on the outskirt of Peshawar, August 31, 1921.'

65. Pastor roseus (L). The Rosy Starling.
♂ November 7, 1925, Peshawar. ' Passes through in large flocks in the late summer and early autumn. The earliest flocks to arrive are composed almost entirely of adult males. In the later flocks young birds and females predominate. They appear to feed mainly on the fruits of various species of *Ficus*. In spring they appear either to go to their breeding area by another route, or to pass through the valley without halting. I have only seen them in the spring twice ; on April 13, 1924, when a small flock left a group of trees at dawn and flew steadily westward ; and in April 1925, when large flocks passed through between the 21st and 25th of the month. Earliest date seen on the southward migration July 14 ; latest date October 21.'—(Briggs). In 1925, however, Osmaston saw small flocks early in November.

66. Sturnus vulgaris porphyronotus (Sharpe). The Central Asian Starling.
♂ November 18, 1925, ♂ November 21, 1925, ♂ December 2, 1925. Peshawar.

67. Sturnus vulgaris poltaratzskyi (Finsch). Finsch's Starling.
♂ November 7, 1925, ♀ November 21, 1925, ♂ November 24, 1925, ♂ December 2, 1925, Peshawar.

68. Sturnus vulgaris humii (Brooks). Hume's Starling.
Under the heading *Sturnus humii* the following appears in *Nests and Eggs of Indian Birds*, Hume and Oates, vol. i, p. 369 :—This Starling lays towards the end of April at Peshawar, where I found it nesting in willow-trees in the Cantonment compounds. (See also *Ibis*, 1870, p. 529.)
Both *S. v. porphyronotus* and *S. v. poltaratzskyi* are numerous as winter visitors, and they flock together. The earliest date on which Briggs saw Starlings was October 12, and the latest date April 13, but most years all have left before the end of March. Neither Osmaston nor Briggs identified *S. v. humii*, and the latter found no Starlings breeding in the valley, though after reading the above quotation from Hume he looked for them for six successive seasons.

69. Acridotheres tristis tristis (L). The Common Mynah.
Exceedingly common and a resident. Eggs were found from the middle of April to the end of August, there being at least two broods.

70. Acridotheres ginginianus (Latham). The Bank Mynah.
♀ November 7, 1925, Peshawar. A summer visitor. Breeds in very large colonies in the sand-cliffs near Risalpur. Fresh eggs found in great numbers on May 9, 1922, and May 15, 1923. In the autumn mixes in small flocks with *A. tristis* before departing. Earliest date seen March 22, latest date October 12 (Briggs). Osmaston, however, saw small parties about on his first arrival in 1925, but not after the middle of November.

71. Uroloncha malabarica (L). The White-throated Munia.
♀ November 6, 1925, Peshawar. A resident, but not very numerous. Rarely seen near houses.

72. Amandava amandava (L). The Red Avadavat.
♂ ♀ November 14, 1925, Peshawar. ' Not common, but small parties seen on grasslands on two or thee occasions.' (Osmaston). Many are sold in the bazaars at Peshawar, and Briggs remarks on the ease with which they escape from their cages.

73. Caropdacus erythrinus (Pall). The Common Rosefinch.
' Pass through Peshawar in flocks, staying for a few days in spring. I have never seen them on their autumn journey. They seem to time their arrival at Peshawar to coincide with the ripening of the mulberries, on which they feed. Their numbers vary greatly from year to year. In 1924 the mulberry crop was

good, and the Rosefinches numerous : in 1925 the mulberry crop was poor, and Rosefinches far less numerous. Earliest date seen April 18, latest date April 30. (Briggs).

74. Metaponia pusilla (Pall.). The Gold-fronted Serin.
♂ November 25, 1925, Peshawar. The above young bird, secured by Osmaston, was a solitary straggler.

75. Hypacanthis spinoides. (Vigors). The Himalayan Greenfinch.
♀ November 25, 1925. Osmaston secured the above specimen from a small flock, the only lot seen.

76. Gymnorhis xanthocollis (Burton). The Yellow-throated Sparrow.
A common summer visitor, first observed on April 10. Numerous nests found between May 16 and 23, all in holes in Tamarisk trees.

77. Passer domesticus (L). The House Sparrow.
♀ December 6, 1925, ♂♀ December 13, 1925, ♂♂♂♀♀ January 4, 1926, Peshawar. A very numerous resident, breeding from the middle of March to the end of september or beginning of October. Although commonly building in houses, it frequently builds in trees in the Peshawar Valley, a trait shared by the sparrows of the Quetta Valley, but not usual in the plains of India. Ber trees are preferred. In winter large flocks are found far out from the station in the irrigated land.

78. Passer hispaniolensis (Tschusi). Tschusi's Sparrow.
Recorded by Hume (*Ibis.*, 1870) as being in breeding condition in the Peshawar Valley in April. It was not observed by Osmaston or Briggs.

79. Emberiza leucocephala (Gmelin). The Pine Bunting.
♂ November 29, 1925, ♂♂ December 30, 1925, ♂♂ January 4, 1925, Peshawar. A fairly common winter visitor, in November December, and January, occurring in rather large flocks both in swampy ground and in fields in the cultivated tract.

80. Emberiza schœniclus pallidior (Hartert). The Reed Bunting.
♂ January 9, 1926, ♂ February 8, 1926, Peshawar. Found by Osmaston to be locally common in winter occurring in small flocks in the wet country.

81. Emberiza cia par (Hartert). The Meadow Bunting.
♀ November 14, 1925, ♂ November 15, 1925. A fairly common winter visitor both to the irrigated tract and to the uncultivated country, especially up the Khaibar and at Attock.

82. Emberiza melanocephala (Scop.) The Black-headed Bunting.
Briggs notes that a small flock fed daily in the barley fields outside Peshawar from May 7 to May 20, 1920.

83. Emberiza icterica (Eversm). The Red-headed Bunting.
Passes through in large numbers in the spring, earliest and latest dates April 23, and May 10. Not seen in the autumn, except for a single bird on the outskirts of Peshawar Cantonment on August 13, 1923.

84. Riparia riparia indica (Ticehurst and Whistler). The Small Sand-Martin.
o? December 9, 1925, o? January 1, 1926, Peshawar. Omaston found this form common along the Kabul River and its branches and canals in December, when it was 'singing'. Briggs says that it is a resident and numerous, but subject to local movement within the Valley in relation to the supply of insects. Eggs found February 14 to March 4. They breed in suitable spots in the banks of the Kabul River, and in large colonies in the same sand cliffs near Risalpur which are later occupied by Bank Mynahs. He believes that the Bank Mynhas enlarge and use the hole of the Sand Martins frequently.

85. Ptyonoprogne rupestris (Scop.). The Crag Martin.
A few were seen by Osmaston in November, 1925.

86. Hirundo rustica rustica (L). The Swallow.
♂♂♂♀♀ December 6, 1925. Peshawar. Osmaston states that he found it common throughout the winter months. The above five specimens were secured at a single shot as they sat on a telegraph wire. Briggs says :—Pass through in large flocks in spring and autumn, the autumn flocks frequently

arriving after rain on the hills to the north west. Some are to be seen throughout the year. Those which remain through the summer are probably non-breeders, as I have never seen or heard of a nest, though I once saw one picking up mud from the side of a pool as though to build. It is also possible, however, that some, if not all, of those seen in the summer breed in the hills, and come down to the valley during the day for food. In summer they always appear to be more numerous after rain.

87. Hirundo smithii filifera (Stephens). The Wire-tailed Swallow.
A fairly numerous summer visitor; earliest date seen April 21. Eggs found from May 1, onward, and young seen in the nest as late as September 27. This species sometimes uses the same nest for more than one season, if it is not destroyed by floods. Briggs notes that every nest of this species that he examined was in a position where it was liable to be flooded out, in low culverts. In the summer of 1925, when an unusual number of heavy thunderstorms visited the Peshawar Valley no nest escaped destruction before the young were ready to fly with the exception of one found containing young on September 27.

88. Hirundo daurica (L). The Striated Swallow.
A small flock of Striated Swallows (subsp.?) was seen by Briggs hawking for insects over the Mall at Nowshera on April 13, 1923.

89. Motacilla alba dukhunensis (Sykes). The Indian White Wagtail.
o? November 10, 1925, ♂ November 11, 1925, ♂ ♀ December 15, 1925, Peshawar. A very common winter visitor found in the irrigated area. Earliest date seen September 10, latest date May 4.

90. Motacilla alba personata (Gould). The Masked Wagtail.
A fairly numerous winter visitor. Earliest date seen August 21, latest date May 11.

91. Motacilla cinerea caspica. (Gmelin). The Grey Wagtail.
A fairly numerous winter visitor. Earliest date seen September 22, latest date May 9.

92. Motacilla flava thunbergi (Billberg). The Grey-headed Wagtail.
Large flocks pass through in the spring and autumn, and a few stay for the winter. Earliest date seen September 6, latest date May 13. In the autumn all the flocks appear to be composed of both young and old.

93. Motacilla citreola calcarata. Hodgson's Yellow-headed Wagtail.
♂ Dec. 21, 1925 ♀ Dec. 21, 1925.
Occasionally seen throughout the winter; most numerous in March and April. A few, probably non-breeders, stay all the year round by the Kalapani River.

94. Anthus richardi rufulus (Vieill.). The Indian Pipit.
o? November 27, 1925, Peshawar. Not very common, but occasionally seen in grasslands near cultivation. Briggs found a nest with two partially incubated eggs on April 12, 1921.

95. Anthus campestris (L). The Tawny Pipit.
♂ December 11, 1925, Peshawar. Osmaston says that it is not common, but that he saw it occasionally near the meeting place of the wet and the dry country.

96. Anthus spinoletta blakistoni (Swinhoe). The Water Pipit.
♂ November 2, 1925, ♂ November 11, 1925, o? November 14, 1925, ♂ ♀ December 15, 1925, ♂ December 31, 1925, Peshawar. An exceedingly common winter visitor, found about swamps, and in moist irrigated fields.

97. Alauda gulgula (Frankl.). The Smaller Skylark.
Apparently breeds in the district as on April 16. Briggs found a clutch of five partly incubated eggs at Pajaggi which he attributes to this species.

98. Alauda arvensis dulcivox (Brooks). The Eastern Skylark.
♂ December 12, 1925, Peshawar. A common winter visitor, found in flocks in the fields.

99. Calandrella raytal adamsi (Hume). The Indus Sand Lark.
♂♂ ♀ December 21, 1925. Pabbi ; February 25, 1926. Peshawar. Found by Osmaston in flocks in December, feeding near swampy ground.

100. Calandrella rufescens persica (Sharpe). Sharpe's Short-toed Lark.
♂ January 28, 1926, Risalpur. The above specimen was obtained by Osmastan from a small flock which was very wild.

101. Galerida cristata chendoola (Frankl.). Franklin's Crested-Lark.
♂ November 3, 1925, ♂ ♀ December 3, 1925, Peshawar. Osmaston says that it is widely distributed though not common. Briggs says that it is resident and numerous, but that a great number appear to move to the higher ground surrounding the valley after bringing off their young. Eggs found throughout April.

102. Galerida cristata magna (Hume). Hume's Crested Lark.
Briggs says :—' A winter visitor, most numerous in spring and autumn when on passage.'

103. Ammomanes deserti phœnicuroides (Blyth). The Desert Finch-Lark.
A resident, and fairly numerous on barren ground. Eggs found between May 29 and July 4.

104. Zosterops palebrosa occidentalis (Ticehurst). The White-eye.
♀ November 8, 1925. Fairly common in the wooded areas in winter. Briggs remarks that it appears spasmodically in large flocks, especially after rain.

105. Cinnyris asiatica (Latham). The Purple Sunbird.
A common summer visitor. Earliest date seen March 17 (apart from a straggler, a male in breeding plumage, seen by Briggs in the Khaibar on February 22, 1921). Latest date seen September 11. Briggs found fresh eggs from April 29 to June 1, and heard of earlier and later occurrences. He notes that this species, if undisturbed, appears to use the same nest for a second brood.

106. Picus squamatus (Vigors). The Scaly-bellied Green Woodpecker.
Seen on two occasions by Osmaston in Pirbala wood in January 1926.

107. Dryobates scindianus (Horsf. and Moore). The Sind Pied Woodpecker.
♂ November 25, 1925, ♂ ♀ December 26, 1925, Peshawar. A common resident in all wooded areas in the irrigated tract. The nest-holes are commenced in March.

108. Liopicus mahrattensis aurocristatus (Tickell). The Mahratta Woodpecker.
♂ January 1, 1926, Peshawar. A common resident, found in the same area as the last species.

109. Iynx torquilla (L). The Wryneck.
♂ November 13, 1925, ♀ November 29, 1925, ♀ January 7, 1926, ♀ January 22, 1926, Peshawar. A fairly common winter visitor, and rather more numerous on passage according to Briggs.

110. Coracias benghalensis benghalensis (L). The Blue Jay.
A resident in small numbers ; its numbers are greatly augmented in summer by an immigration about March. Eggs found between April 21 and May 25. On May 15, 1923, Briggs found a Roller sitting on four of its own eggs and one Bank Mynah's egg, in a colony of the latter species.

111. Coracias garrula semenowi (Loud. and Tsc). The Kashmir Roller.
Passes through in large numbers in spring and autumn. A few stay to breed usually keeping well away from towns and villages. Eggs found May 10, 1923, and May 15, 1923.

112. Merops orientalis (Latham). The Bee-Eater.
A very numerous summer visitor, first observed by Osmaston on March 10. Briggs gives his earliest date as March 8, and latest date October 11. Eggs are laid at the end of April or beginning of May.

113. Merops superciliosus javanicus (Horsf). The Blue-tailed Bee-eater.
A summer visitor, less numerous than the last species. It avoids the neighbourhood of houses. Earliest date seen April 2, latest date September 6.

114. Merops persicus persicus (Pall). The Blue-cheeked Bee-eater.
Briggs says :—' Only once seen, and then in large numbers, of which a considerable proportion were young birds : September 6, 1925.'

115. Ceryle rudis leucomelanura (Reich). The Pied Kingfisher.
♀ December 17, 1925. A resident species, common on the Kabul River and its branches. Breeding commences in March, and Briggs found eggs on April 1, 1924.

116. Alcedo atthis. The Common Kingfisher.
♂ November 20, 1925. Fairly common along streams and canals, and apparently resident.

117. Halcyon smyrnensis smyrnensis (L). The White-breasted Kingfisher.
♂ November 8, 1925. A resident, and common throughout the irrigated country and near swamps. Lays at the end of April and the beginning of May.

118. Upupa epops epops. The European Hoopoe.
♀ December 28, 1925, Peshawar. Briggs states :—' Resident and common, but the individuals which spend the winter in and about Peshawar do not seem to be the same as those which breed, as in the autumn and spring there is a period of a few days in which in some years there appear to be no Hoopoes at all, while in other years they appear to be far more numerous than at normal times. The explanation of this would seem to be that the Hoopoes which winter in Peshawar go further north or east to breed, and that their place is taken by birds of the same subspecies from the south. Sometimes those from the south arrive before, and sometimes after the departure of the others. Eggs are laid in the second half of April. Osmaston remarks that Hoopoes were not common throughout the winter, but that they became more numerous in February and March, and that breeding commences in late March. These notes both suggest the marked spring passage which one would expect in the Peshawar Valley.

119. Micropus affinis (Gray). The Common Indian Swift.
Numerous and resident. It breeds chiefly in April, May and September, but occasionally in almost every month.

120. Caprimulgus sp. The Night jar.
Briggs notes that some species is not uncommon in the summer, and that he picked up a fledgling in May 1923.

121. Cuculus canorus (L). The Cuckoo.
One was seen by Briggs on April 23, 1921.

122. Eudynamis scolopaceus scolopaceus. (L). The Koel.
A summer visitor less common in the Peshawar District than further down country. Earliest date heard May 12. Not heard after the end of August.

123. Palæornis nipalensis eupatria (Hodg.). The Large Indian Parrakeet.
Common and resident. Osmaston obtained fresh eggs on March 2, from a hole in a mosque in Peshawar City.

124. Palæornis torquatus (Bodd.). The Rose-ringed Parrakeet.
Resident and numerous.

125. Asio flammeus (Pont.). The Short-eared Owl.
November 17, 1925, Peshawar. Not uncommon throughout the winter in grasslands.

126. Strix aluco biddulphi. The Wood-Owl.
A single bird was seen and shot by Osmaston on November 18, 1925.

127. Bubo bubo bengalensis (Frankl.). The Indian Great Horned Owl.
December 2, 1925, resident. Briggs found two young, not quite able to fly, near the Kalapani River on May 17, 1922. At the same place on another occasion he watched an adult bird of the species being mobbed by two Kashmir Rollers. The Owl was sitting in full sunlight at about 10.0 a.m. on a boulder on top of the cliff above the river, and the two Rollers kept swooping at its head. For about a quarter of an hour it took no notice of these demonstrations

beyond bowing its head slightly as the Rollers came near, after which it flew away. Osmaston notes that it is fairly common wherever there are woods of any extent.

128. Carine brama The Spotted Owlet.
January 6, 1926. The Peshawar Resident. Common around Peshawar wherever there are trees. Eggs found April 1 to 14.

129. Pandion haliaëtus (L). The Osprey.
Seen on the Kabul River by Osmaston.

130. Gyps fulvus (Habl.) The Griffon Vulture.
Said by Osmaston to be common near Peshawar, but the exact form requires verification.

131. Pseudogyps bengalensis (Gmel.). The White-backed Vulture.
Appears spasmodically at all seasons though it is not known to breed in the Valley.

132. Neophron percnopterus (L). The Neophron Vulture.
Fairly common and resident.

133. Gypaëtus barbatus. The Lammergeyer.
Rarely seen near Peshawar. Common in the neighbouring hills and in the Khaibar Pass.

134. Aquila heliaca (Savigny). The Imperial Eagle.
One was seen by Osmaston and Briggs on December 21, 1925, near the Pabbi Swamp.

135. Aquila nepalensis (Hodgs.) The Steppe Eagle.
Not uncommon near Peshawar Cantonments in winter. (Osmaston).

136. Aquila rapax vindhiana (Frankl.) The Indian Tawny Eagle.
A resident and fairly common.

137. Butastur teesa (Frankl.). The White-eyed Buzzard.
One was seen by Osmaston in March 1926.

138. Cuncuma leucorypha (Pallas). Pallas' Fishing Eagle.
One was noted by Osmaston in January 1926 feeding on a dead animal by the Kabul River.

139. Haliastur indus (Bodd). The Brahminy Kite.
Occasionally seen, most frequently after rain towards the end of the summer. (Briggs).

140. Milvus migrans govinda (Sykes). The Pariah Kite.
Very common and resident. Eggs nearly all laid in the first week of March. This species has a curious habit of picking up sticks as if to commence building operations about the middle of September, and continues to do this till the weather turns colder in October, when it seems to do no more till nest-building begins in earnest towards the end of January or beginning of February.

141. Circus æruginosus (L). The Marsh Harrier.
Common near extensive swamps in winter.

142. Circus macrurus (S. G. Gmel.). The Pale Harrier.
Seen occasionally in winter. (Osmaston).

143. Circus cyaneus (L). The Hen Harrier.
Seen occasionally in winter. (Osmaston).

144. Buteo ferox (S. G. Gmel.). The Long-legged Buzzard.
♂ December 21, 1925, Pabbi. ♀ December 30, 1925, Peshawar. A common winter visitor to the irrigated country. In the dry foothills it may be resident in small numbers, as Cock records having taken the eggs of this species about three miles from Nowshera in 1872. (*Nests and Eggs*, vol. iii, p. 126).

145. Accipiter nisus nisosimilis. The Sparrow Hawk.
♂ November 23, 1925, Peshawar. A fairly common winter visitor.

146. Falco jugger (Gray). The Lugger Falcon.
Said by Briggs to be resident, but apparently commoner in March and April than at other times of the year.

147. Falco chiquera chiquera (Daudin). The Red-headed Merlin.
♂ December 22, 1925, Peshawar. A fairly common resident, generally seen in pairs. Eggs taken at Risalpur, March 2, 1925.

148. Falco tinnunculus (L). The Kestrel.
A bird in juvenile plumage was shot by Osmaston on December 21, 1925, near Pabbi. The species is fairly common in the valley in winter, keeping mainly to desert and swampy country.

149. Columba livia subsp ? The Blue Rock Pigeon.
Fairly numerous at Attock, on the cliffs by the Kalapani River, and on rocks near Warsak.

150. Palumbus palumbus casiotis (Bonap.). The Eastern Wood Pigeon.
A few were seen by Osmaston in a large orchard on February 23, 1926.

151. Streptopelia senegalensis cambaiensis (Gmel.). The Little Brown Dove.
A resident, but more numerous in summer than in winter. Breeds throughout the hot weather.

152. Streptopelia decaocto decaocto (Frival). The Indian Ring-Dove.
A very common resident in the irrigated tract. Breeds from the beginning of April to the end of the hot weather.

153. Œnopopelia tranquebarica tranquebarica (Herm.). The Red Turtle Dove.
A regular but not very numerous summer visitor. Earliest date seen March 14.

154. Pterocles indicus (Gmel.) The Painted Sandgrouse.
This species is apparently resident in small numbers at Rustom, some twenty miles from Mardan, in the Buner foothills. As it has also been procured in the Orakzai, about half way batween Bannu and Peshawar, and Mr. Donald procured it west of Shinwari, it is probably more generally distributed in the foothills than is generally known.[1]

155. Pterocles coronatus atratus (Hartert). The Coronetted Sandgrouse.
This species is said to occur near Jamrud.[2]

156. Pteroclurus alchatus caudacutus (S. G. Gmel.). The Large Pintail Sandgrouse.
A few pairs are said to breed in the vicinity of Mardan in June.[3]

157. Pteroclurus senegalensis (Licht.). The Common Sandgrouse.
Capt. Cock's notes on the breeding of the Common Sandgrouse will be found in Hume's *Nests and Eggs*, second edition, vol iii, p. 362.
A few are shot between Nowshera and Attock every year.

158. Coturnix coturnix coturnix (L). The Common Quail.
Passes through in large numbers in April and September. A few stay on in the autumn until well into December, and may, perhaps, if they escape being netted, spend the whole winter in the valley.

159. Coturnix coromandelica (Gmel.) The Rain-Quail.
Said by Osmaston to be common in the fields in November.

160. Ammoperdix griseogularis griseogularis (Brandt). The See-see.
Resident in the low hills surrounding the valley. It may sometimes be found on the outcrops of limestone which rise in the middle of the valley.

161. Ortygornis pondicerianus (Gmel.). The Grey Partridge.
Fairly numerous in the low hills surrounding the valley.

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[1] Stuart Baker, *Game Birds of India*, vol. ii, p. 256. [2] loc. cit., p. 268.
[3] loc. cit., p. 283.

162. Rallus aquaticus korejewi (Sarudny). The Turkestan Water-Rail.
♀ November 24, 1925, ♂ January 26, 1926, Peshawar. Common in almost every swamp throughout the winter months. Very shy, and flushed with great difficulty. The call, heard at dawn and after sunset, is peculiar, somewhat resembling the noise made by a small pig in trouble. (Osmaston).

163. Fulica atra (L). The Coot.
Briggs says that it is very numerous in all suitable localities at all seasons, but repeated search failed to discover a nest. Osmaston, on the other hand, considers it not common.

164. Gallinula chloropus (L). The Water-hen.
Fairly common in winter according to Osmaston.

165. Otis tarda (L). The Great Bustard.
Of the six examples of the Great Bustard which have been obtained in India four can be claimed by the Peshawar District.
The first specimen, a female, was obtained on December 23, 1873, at Hastnagur near Mardan and just north of the Kabul River; a party were found in some fields of mustard and giant millet, and they were so shy that, though they remained in the neighbourhood for some weeks, no other specimen could be obtained. (Hume, *Ibis*, 1871, p. 404.)
Two other females were shot in the same locality on January 6, or 8, 1911. There were about twenty-five of them, and they were observed from roughly December 20, 1910, to the beginning of February. (*Field*, February 11, 1911.)
Finally Sir George Roos-Keppel recorded, in a letter dated December 1, 1917, to the B.N.H.S. (Journal, vol. xxv, p. 745) that one had just been brought in to him from the neighbourhood of Peshawar.

166. Chlamydotis undulata macqueeni (Gray and Hardw). The Houbara.
An account of Houbara hawking on the Jamrud Plain will be found in *Game Birds of India*, vol. ii, p. 195. (Stuart-Baker.) They are commonly hawked about Mardan by officers of the Guides.

167. Lobivanellus indicus (Bodd.). The Red-wattled Lapwing.
A common summer visitor, first observed by Osmaston on February 24, 1926. Briggs observed it occasionally in the winter.

168. Vanellus vanellus (L). The Peewit.
♂ December 19, 1925, Peshawar. Common in flocks in winter on open and wet land. Osmaston first observed on November 12, but found it most abundant in December and January.

169. Charadrius dubius (Scop.). The Little Ring-Plover.
Common on sandbanks of the Kabul River and on the margins of swampy pools in winter.

170. Tringa hypoleuca (L). The Common Sandpiper.
A fairly common winter visitor to the banks of sluggish streams or near pools and marshy ground.

171. Tringa glareola (L). The Wood Sandpiper.
A winter visitor, but not very common.

172. Tringa ochropus (L). The Green Sandpiper.
o ? November 11, 1925, ♀ November 25, 1925, Peshawar.

173. Tringa totanus (L). The Common Redshank.
Numerous in winter.

174. Erolia minuta (Leister). The Little Stint.
A winter visitor, never very numerous.

175. Scolopax rusticola (L). The Woodcock.
Not common, but occasionally seen in woods in January.

176. Capella gallinago gallinago (L). The Common Snipe.
♀ December 4, 1925. A common winter visitor.

177. Rostratula benghalensis benghalensis (L). The Painted Snipe.
'My collection contains two specimens shot at Peshawar, and sent to me in the flesh under the impression that they were Woodcock.' (Whistler).

178. Chlidonias leucopareius (Temm.). The Whiskered Tern.
Numerous in winter, and possibly a resident.

179. Gelochelidon nilotica. (Gmel.). The Gull-billed Tern.
One which had been captured by villagers just outside Peshawar was seen by Briggs on September 1, 1921.

180. Sterna seena (Sykes). The Indian River Tern.
Resident on the Kabul River.

181. Sterna melanogaster (Temm.). The Black-bellied Tern.
Resident on the Kabul River.

182. Rhynchops albicollis (Swains). The Scissor-bill.
Found by Briggs in large numbers on a sandbank in the Indus opposite Attock on April 24, 1923. From the behaviour of the birds it appeared that they had eggs, but a prolonged search failed to discover any.

183. Ardea cinerea (L). The Common Heron.
Fairly numerous on the Kabul River at all seasons.

184. Egretta alba (L). The Large White Egret.
Occasionally seen on the Kabul River.

185. Ardeola grayi (Sykes). The Indian Pond Heron.
♀ December 8, 1925. Common and apparently resident.

186. Nycticorax nycticorax (L). The Night Heron.
Commoner in summer than in winter, but noted at all times of the year.

187. Ixobrychus minutus (L). The Little Bittern.
One was seen by Briggs on July 26, 1920.

188. Botaurus stellaris (L). The Bittern.
Occurs in most of the swamps in tall bulrushes.

189. Cygnus cygnus (L). The Whooper Swan.
Of the five specimens of this species which have been obtained in India two were shot by Mr. M. Donlea out of a herd of seven, on December 12, 1910, near Dera Momin, on the Kabul River. (Stuart-Baker, *Game Birds of India*, vol. i, p. 16.)

190. Cygnus bewicki (Yarrell). The Bewick's Swan.
Of the two specimens obtained in India one was shot by Major P. C. Elliott Lockhart near Mardan, on December 30, 1910 (loc. cit. p. 21.)

191. Cygnus olor (Gmel.). The Mute Swan.
One was shot about the end of March, 1910, by Capt. H O'Brien at Nowshera. It is of interest to note that all the above-mentioned specimens of Swans obtained in the Peshawar District were obtained in the same year. (loc. cit. p. 26).

192. Anser anser (L). The Grey Lag Goose.
Fly over in very large skeins in autumn. In spring they appear to collect on the Kabul River previous to going north. Briggs notes that the two occasions on which Geese flying south seemed to be most plentiful were after rain. He says :—'On August 25, 1922, there was thunder and rain in the hills in the evening. From 9 p.m. to 10 p.m. Geese in large numbers were passing over in a southerly direction almost continuously. The following year rain fell on August 22 and 23, from 9 p m. on the latter night till I went to sleep large numbers of Geese were passing overhead. Each of these entries represent the first record of Geese for the year. In none of the other four years for which I have records are Geese noted earlier than September 4.'

193. Dendrocygna javanica (Horsf.). The Lesser Whistling Teal.
Briggs records that he saw a small flock on October 12, 1922.

194. Casarca ferruginea (Pall.). The Ruddy Sheldrake or Brahminy Duck.
Fairly numerous in winter.

195. Anas platyrhyncha (L). The Mallard.
Numerous in winter on the Kabul River.

196. Mareca penelope (L). The Wigeon.
Not numerous, but a few are shot every winter.

197. Nettion crecca crecca (L). The Teal.
Common in the winter on the larger jhils and streams.

198. Marmaronetta angustirostris (Ménétries). The Marbled Duck.
This species was obtained by Logan-Home near Nowshera. (loc. cit. p. 243.)

199. Nyroca rufa (L). The White-eye.
A winter visitor to the Peshawar Valley, but never very numerous.

200. Oxyura leucocephala (Hartert). The White-headed Duck.
Four specimens of this species have been obtained in the Peshawar Valley. (loc. cit. pp. 304, 305.)

201. Merganser merganser orientalis (Oates). Tho Eastern Goosander.
' . . . I have received them or known for certain of their having been obtained from the Peshawar Valley.' (Hume, quoted in loc. cit. p. 319.)

202. Podiceps ruficollis capensis (Salvad.). The Little Grebe.
Fairly common in the Peshawar Valley.

There can be little doubt that other ducks besides those included in this last occur in the Peshawar Valley, but, beside those observed by Osmaston and Briggs, only such species as are specifically mentioned in Stuart Baker's *Game Birds* as having been obtained in the district have been included.

MODERN MUSEUM METHODS

BY

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Part II

(*With two plates.*)

(*Continued from page 544 of this Volume.*)

Character and Arrangement of Exhibits

The more generally accepted method of exhibiting Natural History specimens is to arrange them in cases in accordance with their respective orders, families and genera, classification being the basic principle which governed the arrangement. The system adopted is an heirloom of the days when no distinct line of demarcation was recognized between the reference or study collections of a Museum and its show collections. The attainment of a clearer concept of the aims and purpose of a Museum as an institution for research and popular education necessitated a change in the treatment of its collections. Such exhibits from the collection as were suitable for purposes of display were installed in the Public Galleries while the main portion of the collection was closely reserved in rooms accessible only on application by students and research workers At the same time the exhibits shown in the public galleries continued to be arranged and divided in much the same manner as those stored in the study collection, i.e. they were shown for the most part as individual exhibits arranged according to their respective orders, families and genera. This classified series was usually supplemented with additional material illustrating various phases such as structure, modification, habits, etc., which formed an index or introduction to the study of the main exhibit. To sum up, the specimens with their labels formed an illustrated text book or guide to the study of Natural History and revealed the extent to which science had progressed in the study of these subjects, and the principles on which this study was based.

The exhibits in the public galleries of a Museum arranged as above indicated, are intended for the layman. Their arrangement is based on principles which are the outcome of knowledge gained by men who have made a special study of the subject and are endeavouring to hand down to the public at large the knowledge so gained.

The exhibits as planned have a powerful teaching value; their effectiveness for the purpose, however, depends largely on how the

visitor uses the material the Museum has to offer. The teaching of the Museum is silent teaching—a teaching which demands an effort on the part of the visitor for whom it is intended. How far is this effort on the part of the visitor forthcoming and how far is the influence of the Museum's teaching carried to the general body of visitors? We might liken the visitor to a Museum to a traveller in a strange country. The traveller who has previously acquainted himself with the traditions, manners and customs of the country he is visiting has his mind prepared to benefit by the impressions he gains by his visit--he might be likened to that class of visitor who, by his knowledge of the principles and motives which underlie the arrangement of the collections in the galleries, is able to understand and appreciate them and to benefit by the lesson they convey. For this quite small class of visitor a collection so arranged is sufficient to provide what is required. A second class of traveller who arrives in a country without any knowledge concerning it, but yet makes an effort during his stay to acquaint himself with the fresh view-points it offers, may be likened to that still smaller class of visitor who, realizing there is something to be gained by a visit to the Museum, makes an effort to absorb somewhat of its teaching: to this class the Museum has still something to offer. Lastly there is that large class of people who travel mainly for pleasure or amusement. They may be likened to ninety per cent. of the visitors to a Museum who visit it mainly from the same motive, quite often because there is nothing better to do, or to keep out of the wet, or for some such reason: people who not only lack knowledge but also the inclination to acquire it, and who form undoubtedly the largest proportion of visitors to a Museum. For them the teaching the Museum has to offer loses most of its force unless that teaching provides something which can arouse and hold their interest and lead them to absorb, unconsciously perhaps, somewhat of the message it intends to convey. A visitor of this type passing through galleries of named and classified animals comes away at the most with the impression that there are a great number of different animals in the world. The special, laboriously prepared cases illustrating particular phases of animal life, labelled in terms he cannot possibly hope to understand, hardly bother him at all, as conscious of his shortcomings, he probably does not even look at them. It follows therefore that the teaching value of the exhibits in such a Museum is lost on the majority of its visitors.

One of the main objects of a Museum being the diffusion of knowledge, the measure of its success will depend largely on the ability of the Museum to drive its message home to the largest number. We are teachers not as a right but only when that which we teach is effective in influencing those whom we teach. If we are invariably confronted by indifference, boredom or even hostility, then we have failed in our objective. If we are eager to capture the interest and enthusiasm of people, to get them to think and work along with us, and are able only to capture indifference, it is obviously necessary for us to address ourselves correctly to the problem before us, not by talking vaguely about goals and ideals but by finding out quite specifically which methods are to be

employed if we are to 'get across' to capture attention, to win regard and induce people to think and act along with us.

The classes of visitors for whom the Museum must provide are :

(1) The Research Worker.
(2) The Student.
(3) Those who visit the Museum without any definite object.

The Research Worker.—The needs of the research worker do not enter into the present discussion which concerns itself exclusively with that part of the Museum collections which are accessible to the general public. The research or study collections of a Museum which are intended for professional or advanced students are installed in rooms to which the general body of visitors are not admitted, and their installation and preservation present problems distinct from those which arise in the treatment of the exhibits in the public galleries.

Students.—As regards the student visitors, one might divide them roughly into three classes : (*a*) University Students, (*b*) Primary and High School Students, (*c*) Members of the general public who are interested in Natural History.

University Students—The needs of the University student are particular and distinct from those of the general body of visitors. He is entering upon an academic study of Zoology which cannot be followed on the broad lines in which Natural History as a whole is treated in the galleries of the Museum. A practical course of Zoology as prescribed for University students implies the detailed study of particular types of animals which are representative of a given group—this study of a particular animal in the totality of its organization enables the student to compare its parts and organs with those of kindred species and helps him to arrive at an understanding of the distinctive characters of the group as a whole and the characters special to the example itself. He thereby obtains an idea of the connection between comparative anatomy and classification, the significance of family, of generic and specific characters.

The students' needs could therefore be met by a specially selected collection of representative types, the details of whose internal and external anatomy are illustrated by actual specimens, models, diagrams and then labels. These types could be arranged in their correct relationship so as to furnish the student with material necessary for the study of a particular group, and at the same time afford him a synopsis of the animal or the vegetable kingdom as a whole. As a supplement to the main exhibit he would require a series of exhibits whose object would be to explain and illustrate by actual specimens, diagrams, etc., the various technical terms used in Zoological description. A collection of this character while it is invaluable to the student entering upon the serious study of a complex subject, goes considerably beyond the needs of the general body of visitors, for the majority of whom it would hold little interest. Such a collection would therefore best serve its purpose by being kept in a room or rooms which are outside the main stream of circulation of the general body of visitors. For the greater convenience of students and for obtaining the

seclusion and quiet that is necessary, admission to these rooms should preferably be by ticket. For greater facility, students should be able to obtain admission cards from the teaching staff of their colleges, while members of the visiting public, desirous of doing so should be able to obtain them from the check rooms at the entrance to the Museum building.

The students' room at the Edinburgh Natural History Museum might be taken as an example of how a collection of this nature should be arranged. A series of vertical cases lining the walls of the room contains carefully selected representative types, classified according to correct sequence, affording a conspectus of the various phyla of the animal kingdom from Protozoa to Man. The exhibits consist of actual specimens, where necessary of enlarged models and of diagrams and labels which are arranged to illustrate the bearing of comparative anatomy on classification. A series of supplementary cases with carefully labelled specimens and diagrams serve as an index to the technical terms used in the description and labels of the main exhibit. The very careful and attractive manner in which the material in this room has been prepared and presented is not the least part of its value as an educative exhibit. The methods adopted in the treatment of a collection of this nature, the design and fixtures of the show cases, the colour used for backgrounds, mounts and labels, the care bestowed in the preparation of the specimens and the methods of labelling, all have a powerful influence for repulsion or attraction. The response obtained from the visitor in examining the exhibits in a museum gallery is similar to the effect produced on the on-looker at a shop window: he may be repelled by a crude display or attracted by an arrangement carefully conceived with the purpose to please. In fact, in the presentation of their treasures, Museums can learn much from the persuasive methods of the window display artist.

Primary and High School Students.—To meet the needs of primary and high school students, many Museums in America, both of Natural History and Art, have adopted the idea of the Children's Museum—a series of rooms in the building, or perhaps an annexe to the building itself, which is devoted primarily for the use of the children. Miss Anna Billings Gallup, Curator-in-Chief of the Brooklyn Children's Museum, the pioneer and perhaps the most successfully conducted institution of its kind, has defined for me the policy and ideals of her Museum. She said that its purpose was to give the children experience with real things, objects of beauty and scientific interest. An atmosphere of friendly hospitality and of understanding of a child's point of view was the basis of all its activities. Through its door children are invited to enter freely and enjoy the story-telling exhibits prepared especially for them. Objects are put into their hands to be handled, admired and compared, arranged, discussed and rediscussed. Games played with objects on display enter into every-day's programme and help to bring into action new ideas in Museum experience which are helpful both to the children and to those who guide the Museum's activities. In providing for children's needs there is wisdom in learning from children what these needs actually are. A trained

guide presides over these activities, whether they be in relation to a group or an individual, and endeavours to bring his instruction into concord with the school life, the home life and other recreational interests of the child. The child learns to look upon the Museum as a pleasure resort and centre of information. He is even provided with a library organized especially for him.

Briefly the aim and purpose of the Children's Museum is to afford intellectual entertainment and instruction of a better type for children. It aims at arousing their observant powers and offering them new fields, interests, study, new hobbies and teaching them in a way children like to be taught, arousing their interest and putting them into the way of finding things out for themselves with just that little help and encouragement that is needed. The feeling about the institution is that it is regarded by its visitors as something of their very own—something with which grown-ups have very little to do. They are welcomed within its walls and are encouraged to use and handle and study its collections, read in its library such books as especially appeal to them, play its games and enter into its out-door activities. That feeling of awe and restraint which inspires the child during a visit to a Museum is not encountered here.

The staff in direct control of this section of the Museum is chosen with care, the selection being governed as much by the capacity of the candidate to 'handle' children as by his or her own knowledge and ability. 'We find out so much about the child here,' said Miss Gallup to me, 'we find out the observant children—the child with a penchant for independent enquiry and the child who is careless at observation. Such a one, given a series of questions, will come back with only half of them answered. He or she is encouraged to go back and study the objects until the whole is revealed. Sometimes we find that a child has no colour sense at all—cannot distinguish between reds and blues. The child's needs are two-fold, mental and physical. The Children's Museum tries to provide for both of them.

During the past year, in the Prince of Wales' Museum we have had for the first time the fortunate experience of handling some 6,000 children and have come to realize something of the interest and enthusiasm which can be engendered in them by an effort directed to meet their special needs.

To come to the more practical side of the question and to illustrate how a Museum may serve its younger student visitors, also those among the general public whose interest is not merely superficial, I do not think that I can do better than by taking the Children's Museum at Brooklyn as an example of how the work may be carried out. The Children's Museum at Brooklyn has served and assisted in the founding of Children's Museums in many foreign countries or in adding them as real departments to already existing institutions. It has been a source of inspiration in the work we are attempting to do here in Bombay, and I gladly pay this tribute to Miss Gallup, its genial Curator-in-Chief for the

help and encouragement I received at her hands during my visit to her institution.

The Children's Museum at Brooklyn is situated in what was once a residential building in a small public park. Its collections are arranged to meet the following purpose :—

(A) To provide a general outline of the animal kingdom by a especially arranged collection of types illustrative of various classes of the animal kingdom, in order to supply a foundation for the study of the subject by making the visitor familiar with the appearance and characteristics of the principal animal classes.

(B) To encourage an interest in Natural History and provide material for its study by the exhibition of a series of exhibits representative of the local fauna and flora.

(C) To extend its teaching to the study of the earth's crust by providing exhibits illustrative of the various minerals of which it is composed.

(D) To co-ordinate its teaching more helpfully with instruction the child is given in the schools by the inclusion of exhibits illustrative of History and Geography.

To sum up briefly the collections are divided into a Zoological and Botanical Section, a Mineral Section and Historical and Geographical Sections.

The Type Collection

Zoology is set forth in a type room of ample dimensions located on the first floor. The various classes of the animal kingdom are presented in specimens, drawings, pictures and models, assembled in cases that line the wall and occupy the central floor space. Beginning at one side, the sequence of development is carried around the room and down and up the central cases so that the skeleton of man, the highest unit, faces the opening study of the amœba. One large label for each sub-phylum or sub-kingdom is fastened on the glass front of the case and similar labels of uniform, smaller size are provided for each class. Strips of moulding carried down the back wall of the case and across its base separate the phyla ; black cords outline the minor divisions thus, by size of label and width of outline the observer will know at a glance which groups are co-ordinate. Another distinguishing feature is the color of the bases or pedestals of the exhibit for all the lower forms, for creatures whose habitat is the water or the sandy shore, they are grey—for the mammals they are black or very dark. The labels and their frames are similarly distinguished. In the whole arrangement the display is restricted only to such specimens as will show in clear outline the important successive stages in the development of the subject. Excessive detail is avoided as this is confusing to the youthful mind. Pictures are used to show tiny forms many times magnified, and to explain a label further or to represent some form absent from the sequence, some form which must be listed because children are interested in it, such as the elephant among the Ungulates, an order sufficiently represented in the exhibit by two specimens.

The labels are mostly couched in popular language but as is generally unavoidable in labelling a type collection scientific nomenclature will sometimes predominate and the direct appeal of the label to the child will consequently be lessened. This is where the work of a docent or guide is most welcome. While the Zoology collection as a whole is for pupils of the higher grades, the teacher of any lower grade may feel sure that her pupils will receive much benefit from a visit to the museum. For very young children the description specializes in well-known animals and calls attention to colour, beauty of form, and other striking characters. The guide thus finds something to interest and instruct the child whatever its age or grade may be till the story of the Ascent of Man is almost unconsciously learned. The lecturer makes a point of talking about just such exhibits as the child himself has recognized, talking about these first and then going on to other familiar animals, he is able to give the child a desire for more 'stories'. The child asks questions and learns more about the exhibits, and gradually acquires knowledge of many animal forms, knows something of classification, and story of the Evolution of Man. The important point in the arrangement of a systematic collection on the above lines, is that the collection should be kept as small as possible. The inclusion of an excessive number of exhibits only tends to confuse the issue; it should be limited to the inclusion of such well-marked forms as will suffice to indicate the limit of variation in a particular class of animals and illustrate the inter-relationship of the animals included in that class. One should always bear in mind that one is providing for the amateur and not for the professional.

Local Bird Life

A second series of exhibits illustrates the bird life of the local park. The birds are attractively mounted, shelves are not used as they tend to produce a monotonous line in this form of exhibition. The birds are fixed to the walls of the case on brackets and are arranged in cases according to the season during which these birds can be seen in the park. Thus you have cases of permanent residents, of winter residents, occasional visitants, summer birds, spring and autumn migrants. The series gives a graphic idea of local bird life as it illustrates species which can be actually seen in the child's neighbourhood. The importance and the value of an exhibit illustrative of the local fauna, is too obvious to be stressed. An interest in nature and later in natural history commences or arises from an interest in the animal or plant life of ones immediate neighbourhood, and a collection of this description will not only supply the stimulus to this interest but will also help in its development. In addition, such a collection will meet the requirements of those whose main object in visiting the museum is to identify some animal or bird they have seen in their vicinity.

The Insect Room

This room contains an attractively mounted and displayed series of insects in wall cases which illustrate various features of insect



A Lesson in Minerals
Children's Museum, Brooklyn, N.Y.

By courtesy.

Children's Museum, Brooklyn.

THE CHILDREN'S MUSEUM



THE VIVARIUM IS A GREAT CENTRE OF ATTRACTION TO YOUNG VISITORS.



A CORNER OF THE WELL-USED LIBRARY.

By courtesy. *Children's Museum, Brooklyn.*

life. The collection being intended for children, color and beauty of shape have influenced the selection of specimens for illustrating the various studies, but at the same time the exhibits are arranged on scientific lines so that their full educational value is maintained. The child can here become familiar with local moths, butterflies and beetles. A silk worm and silk exhibit, a hive of living bees and many species of insects that do harm to local trees and crops are included in the series.

The Mineral Room

The Mineral Room of the Museum is one of its most popular features. It is divided into two sections—a series of students' trays containing labelled examples of minerals which the child can examine and handle in a way that children like to do, and a corresponding series of finer specimens which are included in the main exhibition. The object here is to give the child a good working knowledge of minerals. Mineralogy would usually be considered a dry as dust subject for the child, but when attractively presented young people quickly become quite enthusiastic over the science and few types of lone material are more in demand at the Children's Museum than the trays of rocks and crystals, while the mineral and volcano room swarm with little folk. Mineral study seems to have become a tradition with the Museum, and it has developed a department which numbers now among its alumni a mining engineer, a mine operator in Mexico, and the late Curator of Mineralogy at the Public Museum at Milwaukee. All these found their first interest in minerals in the rooms of the Children's Museum at Brooklyn. Although the function of a Children's Museum involves cultural rather than professional training, it augurs well for the subject concerned when such results are obtained.

The Botanical Section

This section includes cases which form an introduction to the study of Botany, the various parts of flowers and leaves, etc., are explained in models and pictures.

The Historical Section

American History occupies five sections, European sovereigns and navigators, American, Indians, settlement and colonial period, the Wars, New York State and City, outlining significant events in national development, all these are set forth in charmingly realistic miniature groups or paintings.

The Geography Room

Outlines primitive life in all parts of the world, polar scenes, jungle and desert, illustrated in minature groups.

The Library

The Library in the Children's Museum contains 7,500 carefully graded and selected books. It is open during the same hours as the Museum, i.e. 9 a.m. to 5.30 p.m. weekdays, 2.30 to 5.30 p.m. Sundays. It is a pioneer library in its own field and has a share in

all the activities of the Museum. It is one of the best and most complete nature libraries in the country, and its books cover a wide range of additional topics, such as travel, history, biography, mechanics and inventions which appeal to the interests of the child. The number of readers exceed 60,000 each year, and quite frequently there are from 400 to 600 children visiting the library in a day. At such time, of course, the children come in relays. The library occupies two rooms, a home-like cheery room for children, and an adjoining reference room for teachers and older students. As far as possible individual attention is given to the readers, first assisting them in the selection of books and leading them to a love of good reading, and second teaching them to get reliable information from books. Information is offered about all the exhibits found in the Museum, and pictures, collections of poems and plays and other data are provided in connection with school studies. The boys and girls who have been working industriously for a certificate of credit from the Museum in animal study, history, geography, or some such subject, come to the library in search of information on a variety of subjects such as protozoa and amphibia, animals found in the South Sea Islands, trees and vines of Brazil, and the Berbers of the Sahara Desert. Again the librarians get inquiries from children about their own city. On such topics as the different types of bridges in New York and their construction, and how the subways and tunnels are built. To show how the library is being used by the children I might say that a girl composed a little play entitled : 'Christmas in Mother Goose Land,' which her classmates supplemented with poems found in the library. Needless to say, the library offers considerable attraction to Boy Scouts and Girl Guides. They come in to identify flowers, birds' nests, mushrooms and shells, and to inquire about aquaria, snakes, and a number of things which interest them.

Among the library's activities is the holding of exhibitions of paintings and pictures appropriate to time and season, thus the birthdays of Washington and Lincoln were the occasion for the display of pictures relative to the life of these men, and attendance at these exhibitions is always very large. In this way books and periodicals were used by hundreds of boys and girls, quite a large number of whom wanted books and stories about these national heroes. These patriotic pictures attract the children and even the adults, while reproductions in colour of paintings representing scenes in the history of the country give them an idea of the story of their land and what it means. In connection with these pictures the library posts up lists of plays and pageants, flag drills, etc., appropriate to the celebration of America in the making. There is also a list of stories of countries, comprising titles of books about eighteen European countries which had some share in the growth of America. I have written at length on the activities of this library because it is not usual to find work of this nature in institutions such as these. The policy adopted by the Children's Museum Library shows just how very active and helpful a library can be and to how many different fields of interest and endeavour it can lead its users.

Educational Work

Musuem Courses

Opportunity is given to the children to work at the Museum in eight different subjects represented by its collections. A student may begin to work at his convenicnce and spend as much time as he pleases on any course. The whole thing is left to the will of the child and no blame whatsoever attaches to him if he stops off and fails to complete a course. 'We leave them to develop their ideas by themselves,' said Miss Gallup. 'Sometimes they tire of a thing, and leave off; but mostly they come back again.' The completion of each course entitles each child to a certificate of credit which counts towards a medal. A bronze medal is awarded for fifty credits and a silver medal for a hundred credits. Courses may be chosen in any order. The courses and amount of credits against them are as follows:

A child desiring to take a course in Minerals applies for a leaflet giving the requirements for a certificate in mineral study. He then asks for a 'model notebook' on mineral study which gives him directions how his own notebook is to be kept. In answering the questions he records his description in pencil in his own notebook. He gets from the library a book on minerals and from the docent a streak plate for testing minerals, a box of minerals giving the scale of hardness of various minerals, and the first student's tray of minerals containing twenty named important minerals in compartments. Each compartment bears a letter and a number which corresponds to those on the specimen and in addition the name of the mineral and its chemical composition is attached to the compartment, i.e., the first tray is A, the first compartment would be A1 and below it is a label marked "A1 iron pyrites, Fe S2." With this equipment the child commences the study, his note book must be the record of his own observation. He must not crib from a text-book and the value of the work to him will depend upon his own independent action. The book is only to be used as a reference—if he cannot find the answer to any question at once about any particular specimen he is recommended to leave a blank, for in some later tray he will probably find a specimen which will give him the information he is after. It necessarily follows that the first specimen and the first tray take quite a long time to do, but once he gets into the way of working, things become easier for him. After completing A^1 he takes up A^2 and so on, then he goes on to the B series, where he will find some new minerals and also some duplicates, which will add to the information of those he examined first. After studying the first three trays it is suggested to him that he should mix up the minerals of the next tray and see how many he can identify at sight. I have taken mineral study as an example, but it is obvious that the methods used here can be applied to every other phase of life. The whole objective of the courses is to help the child, firstly, by giving him an incentive to work in the shape of a prize, secondly, permitting him to work independently, to allow him to handle exhibits and find out things for himself, with the least possible assistance. Naturally, these methods give the child an interest in the work by putting him 'on his mettle,' as it were.

Museum Games

Among the features of the museum are the games it organizes for its visitors, games which are both interesting and educational. A child wishing to play the ' bird game ' is given pictures of twenty-five birds exhibited in the gallery and he is asked to go out and pick these out. The next stage is to give to him twenty-five names and tell him to find these birds in the collection ; in this way he becomes familiar with quite a number of birds and is able to tell them at sight. There are various games of this type covering various phases of animal life adapted for children of various grades. A child who can identify twenty-five birds is allowed to take a stuffed specimen in a small glass case home for a few weeks. He has learned everything about this specimen and tells his people about it, and takes it to school and tells his classmates about it. They in their turn get interested and want to have a bird of their own and so the interest in the museum spreads.

Stereoscopic Views

Every afternoon during the week a crowd of from twenty to fifty children congregate in the History Room where a dozen stereoscopes and a store of views are brought out under direction of the museum attendants and placed at their disposal. Geographical views, pictures of wild birds and flowers, prove particularly popular, and more than six hundred children enjoy the use of these stereoscopes each month.

(*To be continued*)

REVIEWS

1. A HANDBOOK OF THE BIRDS OF EASTERN CHINA, (Part IV). By J. D. D. La Touche (Taylor and Francis, London; 7*s.* 6*d.* net.)

We have already had the pleasure of noticing the publication of the first three parts of Mr. La Touche's *Handbook of the Birds of Eastern China*, and now have to welcome the appearance of Part IV, dated August 1927. This deals with the families Ploceidæ, Fringillidæ, Bombycillidæ and Hirundinidæ which are well represented in India: indeed many forms described by Mr. La Touche are identical with our Indian birds, whilst others are closely allied to them.

Two new races are described in this part, *Emberiza cioides vagans* (type locality Amur Bay) and *E. c. fohkienensis* (type locality Foochow). It is interesting to note also that the author accepts Dr. Sushkin's opinion that *Emberiza godlewskii* should be treated not as a race of *Emberiza cia* but as a separate species with races of its own.

A new feature in the present part is that under various species the author includes a brief resume of the races, including extra limited forms: this is undoubtedly useful. It is a pity however that the plumage descriptions are somewhat irregular in method of treatment. Some are very diffuse and tend to become almost a catalogue of specimens in the author's collection; others err by incompleteness, mentioning only a single sex. All the same we are able to congratulate the author on the completion of this further instalment of his book, which will be of the greatest possible value to all who are interested in Chinese ornithology and especially to those who look forward to the resumption of active fieldwork in China when her present troubles subside.

Indian ornithologists should note that in treating of the Red-rumped swallows (*Hirundo daurica*) Mr. La Touche does not agree with certain details of the distribution east of India of the subspecies *striolata* and *nipalensis* given in the new edition of the Fauna; the study of these swallows in India is very perplexing and a correct estimate of their distribution remains to be written. Mr. La Touche's remarks should therefore be consulted by students of the group.

This part contains a map to be substituted for that already issued in Part III in which an error has been discovered. It also contains four halftone plates to illustrate types of country, and it is interesting how similar much of the country appears to that of India.

H. W.

2. THE LITTORAL FAUNA OF KRUSADAI ISLAND IN THE GULF OF MANAAR WITH APPENDICES ON THE VERTEBRATES AND PLANTS. By Various Authors.

This interesting publication marks the revival of a serial publication—Bulletin of the Madras Government Museum—which, as is stated in the editor's foreword, has been in abeyance since 1907.

The series will hereafter be issued in two sections, the Natural History and General Sections, and the number under review forms No. I of vol. i of the Natural History Section of the *New Series* of this publication. As the general title of the work indicates it deals with the Littoral Fauna of Krusadai Island in the Gulf of Manaar, and is a systematic account of practically all groups of Invertebrates excluding Protozoa, Porifera, flatworms and some of the smaller groups. From amongst the Chordates only the Urochordates have been dealt with, while a list of the Vertebrates generally is included in an appendix. An account of the Flora of the area is published as a second appendix.

The volume has been prepared primarily for the use of the students who will be working in the Biological Station which is proposed to be established on Krusadai Island and should serve as a very valuable handbook. The visits of the students, as is pointed out in the introduction can as a rule only be of short duration, and if full value is to be obtained from them some ready means, by which at least the commoner organisms that will be met with can be identified, must be provided. In Europe this can to a great extent be done with the aid of the many excellent monographs that have been published on various groups. But in India, few such monographs have yet been written. To prepare a complete and self-sufficient monograph of the fauna and flora even of so small an area as that under consideration, with a full account of the classification of every group, would swell the work to an inordinate size with matter which would be largely a repetition of the work of others already published elsewhere. And, however convenient it might be, it would be undesirable ; in as much as it would help to confirm the impression which students so often get that all knowledge is to be found between the covers of their text-books. On the other hand, to write an account which could only be followed by specialists or with the aid of books that cannot, for some time at least, be available on the island, would be to defeat the object of the work. We have therefore followed as far as possible the classification set forth in some standard text-book such as the Oxford and Cambridge Natural Histories. The particular book followed has been mentioned under each group and should be consulted for details. As, however, only the broad outlines of classification are dealt with in such books, reference is given to other works that have been found helpful in connexion with more detailed classification, and it has usually been necessary to insert a brief account of the distinctive characters of such of the smaller subdivisions as are represented in the collections. These have been kept as short and clear as possible, only the most useful characters being included. But keys have as a rule been avoided on account of the sense of completeness and finality which they are apt, often falsely, to convey. Descriptions of species have also been kept as brief as possible, especially in the case of those already described in the publications of the Indian Museum, in Alcock's 'Materials for a Carcinological Fauna of India'[1] (1895–1900), in

[1] *Journ., Asiatic Soc., Bengal*, 1895–1900.

Stanley Gardiner's 'Fauna and Geography of the Maldive and Laccadive Archipelagoes', in the reports of the Percy Sladen Trust Expedition to the Indian Ocean[1] and in Herdman's 'Report on the Pearl Oyster Fisheries of the Gulf of Manaar', works bearing in so definite a manner on the fauna under consideration that they must obviously be available for reference along with the standard text-books already mentioned in the library of the Krusadai biological station.

The different chapters dealing with the various groups have been written by different authors, but the greater part of the volume is the work of Dr. F. H. Gravely, Superintendent of the Madras Museum, who has also acted as the editor for the remaining contributions, and Dr. B. Sundara Raj, Director of Fisheries, Madras. In each case the commoner forms met with have been dealt with in sufficient detail for identification and very instructive line and dot drawings of the species have been published. Fairly extensive literature references have been included at the end of each chapter and these with the work under review should enable students to identify most of the commoner forms, which are found in the region.

A general description of the island and other collecting grounds in this region together with maps of the different parts is also included.

The work is by no means the last word on the subject and as the editor remarks will need revision after the various groups have been revised by specialists.

The editors and the authors, however, deserve the thanks of students and incidentally of others interested in Marine Biology on producing a really useful handbook on the littoral fauna of the island and the adjacent parts, and it is sincerely hoped that it will stimulate more detailed research on Indian marine fauna of the region.

The printing and general get up of the work is really excellent and the price (Rs. 8) for a work of its size with 26 plates, is by no means exorbitant.

B. P.

3. WITH A CAMERA IN TIGER LAND. By F. W. Champion, M.A. (Oxon) F.Z.S., Imperial Forest Service of India. [Chatto & Windus, London, 1927. Price 30*s*. 228 pages, 73 illustrations.]

Books dealing with sport and the natural history of the fauna of India have hitherto almost without exception, been conceived and written with the object of describing the methods and adventures which lead to the destruction of animals.

In his book *Wild Animals in Central India*, reviewed in this Journal (volume xxix, page 1032) Mr. Dunbar Brander rightly remarks that when not bent on slaughter, one sees and observes far more of the animals of the forest. Mr. Champion advances us much further than that, and in the book before us, which he correctly claims to be 'the first book ever published which is illustrated throughout with

[1] *Trans. Linn. Soc. London* 1907 onwards.

photographs of wild animals just as they live their every-day lives in the great Indian jungles', does a real service to the wild animals he loves so well, for we venture to predict that an increasing number of sportsmen will endeavour to live up to his teaching and example.

'It is better' we have recently read somewhere 'to hold the hand of Nature and to look into her eyes than to alienate and slaughter her.' That is the spirit in which this book has been conceived and written.

The first three chapters give us charmingly written pictures of 'A Day in the Jungle', 'A Night in the Jungle', and an account of what is truly described as 'An Extraordinary Experience'. Those of his readers who have had the fortune to wander on elephant back through the submontane forests of the Himalayas, must vividly recall to mind days similar in a general way to that so faithfully presented to us. The coming upon the tiger and his kill has happened to some of us, but to few of us has been vouchsafed the sight of the wild elephant: and it is quite certain that no one of us has photographed him in his natural surroundings as has our persevering author.

The extraordinary experience related in Chapter iii must be quite unique, and such photographs as plates xv, xvi, xvii, are unlikely to be again obtained.

We take the volume in the order in which it is arranged, but keep the elephant to the last. With the chapter on monkeys there are seven excellent photographs depicting the common Brown or Bengal Monkey and the Langoor, these being the two species of primates found in the forests of the United Provinces. With the remarks of the author as to the 'cruel iron bars' of the cage of capitivity most of us must be wholly in accord, and we hope that the time will come when such things will be condemned by public opinion.

Mr. Champion expresses himself as absolutely convinced that a langoor, if he calls four or five times, does so because he can actually see a tiger or a leopard. On this point we would remark that we have seen langoors give the alarm call at sight of a yellow dog-and this not once only but on several occasions—while the smaller monkey never took any notice of it. Otherwise also, in our experience, the langoor is less reliable than his smaller relative, who never deceives the sportsman. The aboriginal tribes of India recognize that the langoor is not always to be relied upon and will give the alarm when *rhesus* would not. Both species provide excellent training for the would-be photographer of animal life in the forests.

Of tiger in general the author writes with the knowledge born of careful observance, and has much that is interesting to relate. He rightly concludes that the sense of smell possessed by tigers is weak: 'practically non-existent' in his opinion; but we would not put it so low as that, and would say that it is not more highly developed than that of man.

As to the 'twelve-foot tiger' the 'probability' that many of these lengths were taken from skins after they had been removed from the carcasses was amusingly confirmed to us only three years ago. A sportsman who shot three tigers in one beat reported the fact to the

civil officer of the District, stating in all seriousness in his letter that the animals he had shot measured 13 ft. 6 in., 12 ft. 9 in., and 11 ft. 7 in., respectively. It was ascertained that these lengths were obtained by taping the fresh skins, pulled out serpent-wise to their fullest extent! That method of measurement is no doubt the orgin of the 'twelve-foot' tiger.

The sport of photographing tiger is fully described. The author, having fixed for himself the high standard of obtaining photographs of animals under strictly natural conditions, and 'not where he is the pursuer or pursued', rules out the employment of beating for the production of photographs of tigers; and explaining that he has never yet had a tiger come near a machan in daylight, in a light good enough for a picture to be produced, he proceeds to describe two other methods.

One is 'ghooming' (not 'ghumming') an anglicized colloquialism of a Hindustani word, or wandering about in hopes of a 'subject'; and the other the stalking of a tiger on his kill. A well-trained elephant, with an equally well-trained mahawat (we like that spelling of the word) is essential to either method. But the experience of the author, after years of continuous effort, is that but few pictures are obtained in proportion to the amount of energy expended; and he comes to the conclusion, which is borne out by the vivid 'action' of his flashlight photographs, that this is the best method of all.

Success, however, the author remarks, is only to be obtained by dint of perseverance and determination to succeed in spite of repeated failures and the risk of contracting severe attacks of malarial fever. In some other parts of India the fever risks would not be so great. Justly, however, can the author claim that automatic flashlight photography is 'not too easy to be sporting'.

In the enlarged copy of the head of the tiger of plate xiv, xxi which forms the frontispiece of the book, we see the size to which the pupil expands in the dark and can realize how it is that, however fine the trip-wire may be, it will most likely be detected, as is shown at plate xxx. Also we realize the delight of the author when he developed this plate!

We are given an interesting chapter on tigers and their prey, the author coming to sound and right conclusions on this as on other matters he discusses. Tigers do not always seize their prey in the same manner. 'Circumstances alter cases' and, as indicated by a photograph on p. 587 of Vol. xxxii of this Journal and witnessed by the present writer under electric light, a tiger, when the prey is easily within his power, does not necessarily break the animal's neck, but seizes it in a vice-like grip until life is extinct.

In these days of modern photography the aim of all enthusiasts is to obtain a photograph of tiger in the act of killing his prey. Mr. Champion has not yet succeeded in obtaining such a picture and it can be fairly safely asserted that only by cinema photography, carried out by daylight under previously prepared conditions, will such a photograph be obtained. Nevertheless we hope that our persevering author's efforts in this direction will be crowned with success.

Of leopards and the smaller cats we are given some excellent pictures and interesting reading. It is remarked that in the detection of the trip-wire, however fine it may be, the leopard is even superior to the tiger. That is an instance of knowledge coming to us through the photographing of animals in their natural surroundings.

The author might, with accuracy, have asserted more positively that the leopard cat is less common than the jungle cat (*Felis chaus*).

The photograph at plate xxxiv is that of the Small Indian Civet (*Viverricula malaccensis*) and not of the Large Indian Civet (*Viverra zibetha*) as it is without the distinctive *Viverra* crest along the spine.

Under the heading 'Hyænas and Others' we see pictures of hyænas and jackals only. The absence of a photograph of the animal popularly known as the wild dog is to be regretted; but, as the author says, it would take many, many years successfully to portray photographically all the interesting creatures of the jungles.

Mr. Champion is correct in stating that there are large numbers of hyænas in the forests. They are very common animals. We are at one with the author in doubting that a leopard will abandon his kill to a hyæna, also we agree that the hyæna of the forests is a particularly silent animal. The killing of tethered goats by hyænas is within our experience, also we have personal knowledge of a hyæna having killed and eaten a woman and a boy and attacked another woman.

Of the rodents, photographs of the Indian Palm Squirrel and of the porcupine are given. In view of the certain knowledge we have that leopards frequently kill porcupines for food it is not probable, as the author remarks, that they often inhabit the same dwelling.

Of the deer tribe we have good photographs of the stag and hind chital, but none of the noble sambur stag, or of the ubiquitous barking deer. The absence of pictures of these animals, so common in the forests known to the author, emphasizes the difficulties in the way of successful animal photography under natural conditions.

Of 'Antelopes and Others' there are pictures of blue bull, and a silhouette of a distant gural; also a photograph of two wild boars in a characteristic attitude. Mr. Champion is correct in stating that the serow is to be found at elevations considerably below 6,000 feet.

The wild elephant has, perforce, to be photographed by day, and in doing this Mr. Champion has been eminently successful. He gives us much interesting information as to the manners and habits of both tame and wild elephants. Both the chapters are exceedingly interesting, and the photographs among the most striking in the book.

In justice to the author we must touch but lightly on all he tells us and leave the reader to his certain enjoyment of it. He will learn much of what the author terms the fascinating pursuit of photographing wild elephants, will read of some highly exciting incidents, and generally learn much that he did not know before.

The final chapter of the book is on photography. Willing and helpful expert advice on cameras, lenses, plates, etc., is given; also especially valuable practical instruction as to the flashlight

photography by means of which the author has been able to secure, and produce for our instruction and enjoyment, so many excellent pictures.

However, he makes one statement which calls for comment. This is in regard to Marius Maxwell's 'Big Game Hunting with a Camera in Equatorial Africa'. According to Mr. Champion "nearly all his (Maxwell's) pictures were produced with an ordinary 8 in. lens, and strange to say, without a reflex camera". We cannot understand how Mr. Champion can have derived the impression that Maxwell did not employ a reflex camera in face of what that author says at the very commencement of the book, in his lucid and instructive chapter on 'A Camera Huntsman's Equipment' (page 3, para 3). Plate I of this chapter, moreover, depicts the camera chiefly used by Maxwell, which is manifestly a short focus reflex.

We do not know what Mr. Champion's sources of information may be for stating that Maxwell's method of photographing big game was "to stalk up to his subject and then to expose plates at close range, *often by holding the camera over his head and centering the animal by means of a direct vision view finder*". From a perusal of Maxwell's book one certainly does not gain the impression that this method was often adopted. It may perhaps have been only in a very exceptional instance that it had to be resorted to.

Of the game animals of India the author has photographed seven in their natural surroundings and at close range. In the mountains, plains, and forests of India and Burma there are more than thirty-seven! So there is plenty of room for those sportsmen who will abandon the rifle in favour of the camera and preserve pictures instead of horns, and hides, and hoofs, of the game animals of this country. Through animal photography such as is put before us by Mr. Champion, the sportsman will obtain records more permanent than perishable trophies; the naturalist, the sculptor, and the painter will all have pleasure in and profit by his labours.

The duty of a reviewer is to criticize, withholding nothing adverse if such be found; but we close this book with no note of dissent, and feel sure that a wide circle of readers will enjoy it with very deep interest. More especially will it be appreciated by those who themselves know and love the vast jungles of India and have at heart the preservation of their wild inhabitants from useless destruction.

R. B.

4. DWELLERS IN THE JUNGLE. By Lieut.-Col. Gordon Casserly. [Ward Lock & Co., Ltd., London and Melbourne, 1925. 255 pages, 16 full-page illustrations by Warwick Reynolds. 5*s*. net.]

5. IN THE GREEN JUNGLE. By Lieut.-Col. Gordon Casserly. [Ward Lock & Co., Ltd., London and Melbourne. 255 pages, 16 full-page illustrations by Warwick Reynolds. 5*s*. net.]

The stories of animal and bird life in 'Dwellers in the Jungle', given to us by Lieut.-Col. Gordon Casserly, are exceedingly well told and hold the attention of the reader from cover to cover. The word painting of the scenery of the great forests of India is

good, the style easy and attractive, and the natural history in the main quite accurate.

We are told of the baby wild elephant and how his mother saved him from the murderous onslaught of a tiger : and of a tame elephant (this being a story built upon an actual occurrence) roaming wild for the best part of a year and returning to her bondage. The use of the word ' galloping ' to express the utmost pace of an elephant is misleading to those readers who have not seen this animal moving out of a walk. The two stories of wild and tame langoors are natural to life and realistically told, as also that of the jungle cock and of the weaver bird, and in ' The Warden of the Ford ' the way of the man-eating crocodile is faithfully presented to the reader.

In ' The Hated Horde ' the story of the wild dog of the Indian jungles is well depicted. The author describes these animals as hunting in full cry, and mostly, though not always, at night. We believe it is a fact that *Cuon dukhunensis* hunts entirely by day, and on the several occasions on which we have actually seen them in pursuit of their quarry they have been running quite mute. No doubt there would be some eager whimpering when the climax of the hunt is reached.

Of the many other natural history incidents, and the like, related to us, we doubt the king cobra attaining a length of 18 feet; and have not before known that the python, or any other snake, first secures its prey by flinging a coil after the manner of a lasso. The hyæna does not wear a perpetual snarl, but, like all other animals, bares his teeth only when he has reason to do so. The term ' buck ' we would reserve for the male of the goat species and think it a misnomer for the deer tribe.

With these few criticisms in mind we commend the book wholeheartedly to all lovers of nature study, and the glamour of the great forests of India and their denizens will be with them as they read.

' In the Green Jungle ' is not a wholly accurate title as the opening story is that of a camel of the Great Sahara Desert, and a very good one it is. The life of the ubiquitous jackal is excellently well related. The ' Law of the Jungle ' is the story of a man-eating tiger. His fitting end is doubltess based upon an actual incident of the kind. Throughout the forests of India are many ancient ruins and what the wild life may be amid some of these is vividly described.

Of the gallant wild boar, the ruthless python, the swift hunting-leopard, we are given absorbing tales. The story of the white ant is good, and in ' The Mockers ' the langoor again provides interesting material.

There is but little room for criticism. We would not call the ' Did-he-do-it ? ' which is a lapwing, a long-legged fowl.

The book is of merit equal to that of the former volume, and we close it with similar commendation to the readers old and young alike.

R.B.

EDITORIAL

We have recently welcomed—and very warmly—another expedition sent out to India to obtain further material for the Natural History Museum in New York, and by careful o bservation by trained artists in the actual haunts of our big game to learn how best to exhibit the denizens of our jungles to the public of America.

The expedition was organised some years ago by Mr. Arthur S. Vernay, a business man of London and New York and incidentally an enthusiastic big game hunter and naturalist, in collaboration with Col. J. C. Faunthorpe, late Commissioner of the Lucknow Division, United Provinces. Its object was to secure a representative collection of the game animals of the Indian Empire for the American Museum of Natural History, New York. Through the active support of the Government of India the expedition received exceptional facilities for achieving its purpose, with the result that a series of very beautiful groups illustrating the game animals of this country are now being prepared for the Hall of Asiatic Mammals at the New York Museum. To complete the work and in order that the groups of animals exhibited might be shown in their natural setting, Mr. Vernay arranged in December last year for two experts from the staff of the American Museum, Mr. Albert Butler and Mr. C. C. Rosenkranz, a noted landscape painter, to visit India with a view to studying the actual areas where the animals were obtained, collecting forms of plant life typical of these areas and painting pictures and taking sketches of the country in which the animals lived. Mr. Vernay considered that the Museums in India should also benefit by this work and he accordingly very generously invited Mr. S. H. Prater, the Society's Curator, to accompany this expedition and also provided the funds for Mr. K. B. Savardekar our Museum artist, who has painted some excellent backgrounds for groups in the Museum at Bombay, to be a member of the party. Mr. Vernay's generosity has not only enabled the staff to acquire first hand knowledge of up-to-date methods in the field but has also enabled our Museum to secure a very beautiful series of paintings and photographs taken in the forests of India and Burma which will serve as studies for realistic settings for groups which the Curator is now preparing.

In addition to the above Mr. Vernay has presented the Society with a copy of a remarkable film recording the work the Vernay-Faunthorpe expedition in India. Taken at a cost of nearly £6,000, the film records scenes of animal life taken from Nature in the forests of Nepal, Burma, Central and Southern India. Rhinos, Wild Elephants, Tigers, various forms of Deer and even some of the smaller and less known animals of the Indian Jungle play the leading role in this film which is the finest record of animal life ever made in this country.

It is remarkable that a man who has had but a remote connection with this city has seen fit to do so much for one of its public institutions. Museums have been ever dependent for their origin, their growth and development, on private enterprise and on the support of citizens, who take a pride in their city and its institutions. If a stranger can do so much, surely there must be many in this city who would come forward in the same way to help their own Museum if they realised how rapidly it was taking its place as one of the finest institutions of its kind in the East, and how increasingly it was fulfilling its mission as a centre of culture, of popular education and entertainment.

Mr. Prater was away about two months and was accompanied by our artist whom, thanks also to the generosity of Mr. F. V. Evans—one of our Vice-Patrons—we have been able to send on the journey. We say thanks to Mr. Evans as he is providing the salary for a second artist to prepare models of the fish of our coasts and rivers and at the moment this permitted of our sending Mr. Savardekar with Mr. Prater. When in Mysore the party was looked after by one of our members—Mr. R. C. Morris of Mysore to whom our thanks are due.

We are very glad that we were able at the present time to give Mr. Prater and our artist this opportunity, as our hopes of being able shortly to erect a modern

Natural History Museum are steadily increasing. In our last editorial we had the pleasure of thanking Sir David Ezra for his donation of Rs. 5,000. Now we have a similar pleasure in recording a donation of £500 from Mr. Vernay towards the cost of equipping the New Museum. Mr. Vernay thus not only gives our Curator the opportunity of learning how to do it, but provides us with the means to enable the Curator to follow the teaching of Mr. Squeers and having learnt the meaning to carry out the job.

Mr. F. V. Evans who gave us the beautiful model of a fly, enlarged twenty-eight times has followed up his gift by presenting us with similar models of the Anopheles and Stegomia mosquitoes, both the work, as with the fly, of the two sisters the Misses Edwardes. As in the former case, so now, we have to thank the P. & O. Steam Navigation Company for bringing these models out free of freight charges. Possibly because the P. & O. did this in the case of the fly, Messrs. Mackinnon Mackenzie & Co., not to be outdone, took home for us for the London Zoo a live elephant free of freight, only charging for the carriage of *Homo sapiens* who went in attendance. We wonder if any one will present the Zoo with a pair of Rhinos so that we can say to them 'You brought out two mosquitoes free, surely it is not too much to ask you should take back free also two Rhinoceroses!'

Our New Constitution

A Special General Meeting of Members of the Society was held on January 31, 1928, when the following resolutions were passed :—

1. That it is expedient that the Society be registered as a Society under Act XXI of 1860.
2. That the draft Memorandum of Association and Rules now laid before the Meeting and which were published in the Society's *Journal* of October 20, 1927, be hereby approved as the Memorandum of Association and Rules of the Society.
3. That the Members of the Executive Committee and Advisory Committee therein named be approved.
4. That Sir Reginald Spence, Mr. H. A. W. Brent and Mr. J. B. Greaves or any two of them, be hereby empowered to take all necessary steps to effect the registration of the Society and to transfer to it all the property and assets including securities and cash belonging to the unregistered Society and for that purpose to execute on behalf of all the members of the unregistered Society all deeds, transfers and other documents which may be necessary or expedient.

The Rules and Regulations as published on pages 385-393 of vol. xxxii were passed with the following slight amendments. Rule 7 was altered to read :

'The capital obtained from life-membership contributions and compounded 'subscriptions shall not be used as revenue but shall be invested in Govern-'ment securities and the interest thereon only utilized as revenue. PROVIDED 'ALWAYS that if and whenever the market value of the investments shall 'equal or exceed the amount of the contributions and compounded subscrip-'tions paid by the existing life-members and the members who have com-'pounded their subscriptions then and in such case it shall not be obligatory 'to invest any further sums received by way of contributions from life-members 'or compounded subscriptions but the same may be used as revenue.'

At the present time our investments in Government paper exceed the amount paid by life-members now on the roll and we wish to be at liberty to use any surplus as members may, through the Committee, consider to be in the best interests of the Society. For instance it might be in the best interests of the Society to spend some of the surplus life-membership contributions on the equipment of the new Museum.

The other alteration was to Rule 54 and was to the effect that

'No payment shall be made by the Honorary Treasurer without the '*authorization* of the Honorary Secretary, or in his absence, a member of the 'Committee.'

The Society's Assets

The registration of the Society necessitated the statement of the property handed over by the old unregistered Society to the new and registered

Society and members may be interested in the valuations which were given, namely :—

Securities as on December 31, 1927 (Face value)	Rs.	90,000.
Fixed Deposits, Bank Balances and Cash ...	,,	19,156-12-8.
Research Collections	,,	35,000)
Library Books	,,	20,000 |
Publications	,,	17,500 }Nominal value
Journals of the Society	,,	15,000 | for Insurance.
Furniture	,,	7,500)

The Society's Proposed 'Book of Birds'

In 1926 we started work on the painting of the plates for the Society's popular illustrated book on the *Common Birds of the Plains of India*. We are glad to record that our artist has now finished the illustrations in colour of 200 species which completes our programme. Capt. Bates has provided us with several very interesting photographs of Bird Life and a chapter on Bird Photography. The work is therefore nearly ready for the Press and would be so now but that our staff, having so little to do !, have only completed the letterpress for notes and descriptions of about forty species. However, we hope to be able to make a definite announcement as regards price in our next issue.

The Game Books

Writing of price reminds us that the reduction in the price to members of vols. i and ii of the *Game Birds* has caused a revival in demand and has evidently impressed on several the advantages of membership, but we must ask members, who are keen on the publication of another volume, to continue their efforts to induce other members, who have not done so, to buy and those who are not members to become so in order that they should be able to buy cheaply also.

Game Preservation

In No. 2 of this volume we gave our views on Game Preservation in India and in the editorial which appeared in No. 3 we referred to a certain amount of criticism which we had received. We give below in full a criticism by Lt.-Col. C. H. Stockley, a Member of our Advisory Committee who would like to see the sale of game or of the skins or heads of game prohibited. Col. Stockley writes under date January 10, 1928 :—

'My idea on Game Preservation is that concentration on the sale question is essential, as other questions involve dispensal of force and are open to attack : the sale question is unassailable on the crop destruction plea, as the cultivator still retains the right to kill marauding beasts. It is so-called "waste" lands which attract the poacher. It is there he makes his biggest profits and actually unites in small bands with a regular supply system. Witness the results in the Northern Circars and any accessible "waste" lands. Nowhere in India does the so-called "Zemindari" jungle hold any game but a few scattered remnants. I shot all over the country near Nowgong twenty-five years ago and got grand sport I have just been out for ten days and the country is almost bare of mammalian life. I confess to being almost fanatical on the "sale" question, as I have lately seen some of the results and heard more. The elephant question is one that ruins much of our efforts to save game. I had the figures of the Kheddah sales and outgoings, but have lost them. The damage done to crops alone is immense compared with the small results of the sales, particularly in S. India ; while the Forest Department in Kanara in 1922 temporarily offered a reward for the destruction of elephants, but had to discontinue it for want of funds. The Canara elephants were constantly being reinforced by protected elephants from Mysore and possibly even further south I have seen a herd of over eighty elephants within a couple of miles of a railway station in the Coimbatore District, while the rice fields of a Burmese village after the visit of quite a small herd in the rains, have been a really distressing sight, considering how poor the jungle folk usually are. The Kashmir game is doing well, except Markhor. These are rapidly decreasing everywhere they exist, and are vanishing from the Pir Panjal and Kaj-i-Nag. Astor is bad, Chitral worse, and the N. W. Frontier Province will soon lose the last of the straight-horned race.'

Game Preservation and Other Kindred Societies

We referred to the 'Society for the Preservation of the Fauna of the Empire' in the last editorial and stated we intended affiliating our Society to the one at home. We gave a resumé of the objects of the Society in No 1, vol. xxxii.

We now have pleasure in referring to the work done by the Nilgiri Game Association during the year ending June 30, 1927. We notice that as from October 1, 1926, Government transferred the management of the plateau fishery to the Association subject to the following conditions :—

(1) The Association shall regulate fishing in the plateau waters in accordance with the rules and regulations which the Government may prescribe from time to time.

(2) The Association will be at liberty to appropriate all receipts from licenses which they may issue for fishing in these waters, but shall be responsible for the efficient management of the fisheries and the working of these fisheries shall not be a charge on the provincial revenues except to the extent indicated in condition (4) below.

(3) In the event of mismanagement or of infringement of any of the conditions mentioned above, the Government shall be at liberty to resume the control of the fisheries without payment of any compensation ; the decision of Government as to whether there has been any mismanagement or infringement shall be final.

(4) The Government will provide for the supervision of fisheries as well as the game protection work of the Association free of charge thereby also relieving the association of the payment of Rs. 50 per mensem which it has been making to the Inspector of Fisheries the Nilgiris for the latter work.

The question of continuing the payment of rewards for the destruction of wild dogs was discussed and it was decided that the payment of the rewards should continue, although in July 1926 the Government declined to grant to the Association fines levied under Rule 6 of the Nilgiri Game Rules :—

The following were the principal alterations made in the shooting rules :—

(1) Small game shooting shall open with pigeon shooting on September 1, for the sake of uniformity.

(2) That the killing of all monkeys be prohibited.

(3) That the shooting of all Ibex except bucks possessing a well-defined saddle mark be prohibited.

(4) That only one sambhur stag be allowed on season license. On the monthly license one shall still be allowed subject to the condition that it shall not be shot on the plateau.

One of the principal changes in the fishing rules was :—

Permitting the killing of trout of 8 inches or less, such trout not to count against the limit allowed under the license.

We quote the following notes by members of the Association. Major E. G. Phythian Adams (a member of our Society) wrote :—

'The present condition of the big game in the area continues to be satisfactory, but more effective steps require to be taken to stop poaching which is on the increase. The fact that the Nilgiri Game Association has set aside a sum for reporting cases of poaching should be made known to all watchers and Forest Guards and also to the Police whose assistance is needed in checking the sale of game during the close season.

Wild dogs are still too numerous to allow the reward to be discontinued. There was a large pack at Mudumalai in May, while others were working Masinigudy and Anaikatty as usual. A small pack was reported several times on the plateau towards Mukerty.

The small Game season appears to have been an average one.

The Peermund and Bangitappal streams need restocking ; there appear to be no fish at all in the latter. There are several other good streams in the Kundahs which might be stocked with advantage against the time when the Pykara Hydro-Electric scheme will ruin the trout fishing in the Mukerty River. I do not think that any appreciable improvement in the fishing can be expected till steps are taken to reduce the present large number of otters which infest all the streams. Their food certainly consists largely of crabs, but the latter

form part of the fishes' food supply and at the same time keep the number of fish down by destroying ova also those fish which the otters do take are the largest.'

Mr. J. B. Vernede, wrote :—

'All game is decreasing in the Kotagiri District and on the North, east slopes. Sambhur have decreased very markedly and as far as I am aware not a single shootable stag was seen during the season. Small game has also decreased largely, jungle fowl and hares in particular being very scarce.

I cannot ascribe any particular reasons for this decrease though poaching which is rife, may be a contributory cause, also some increase in vermin.

Writing of the year under review in general the Committee record—

(a) *Shooting*—

The year has been on the whole an average one and there is little of interest to record. In accordance with a resolution of the Committee at its meeting held on December 13, 1926 the services of all Game watchers were dispensed with from January 1927 as it was considered that they were of little if any use in checking poaching or for any other purpose.

(b) *Fishing*—

There appears to be a distinct falling off in the quality of the fishing both as regards numbers and size of fish though perhaps not in the average size of the fish in the streams.'

The following amounts were spent in destruction of Vermin—

	RS.
Wild Dogs ...	... 360
21 Otters ...	... 63
Other Vermin ...	... 74

Central Provinces Angling Association

We welcome the publication of the 1st Annual Report of the Central Provinces Angling Association from which we take the following extracts as regards the birth and activities of the Association.—

Early in 1927 a small number of enthusiastic anglers met together in Jubbulpore and discussed the advantages of forming an Association. It was decided to call a meeting of all those interested in angling, and, if the necessary support was forthcoming, to formally consider the question of forming an angling association.

This meeting was held at the Nurbudda Club, Jubbulpore, on March 1927, at which 13 gentlemen were present.

It was decided that the main objects of the Association should be to collect and maintain all records relating to Fishes and Fishing and generally to consider the adoption of any course or methods which might further the advancement of or improve the sport of Angling in the Central Provinces.

As regards progress the report states—

Rivers.—Owing to the fact that the Association only commenced to function practically at the close of the fishing season, it was not found possible to arrange any Association 'baiting'. This will, however, start as soon as it is practicable after the monsoon waters have sufficiently subsided. The number of 'runs' to be baited will, of course, depend on the number of 'baiting' subscribers.

Tanks.—It is to be regretted that, up to the present, it has not been possible to make any satisfactory arrangement with the irrigation authorities for the preferential recognition of the Association in respect of the tanks under their charge.

With regard to identification. It is interesting to note that all the larger carp caught in the water-works area during the period for which this water was open to the Association have been proved to be *Barbus hexastichus* (Day's *Fishes of India*, p. 565, plate cxxxvi, fig. 4), and not '*Barbus tor*' (the ordinary Mahseer). Day records these fish as growing up to 3 feet in length.

The only other fish that have so far been formally submitted for identification proved to be two *Macrones seenghala* (one of the Tengara or cat-fish group), which were caught with a small spoon in a pool in the R. Gaur, upstream of the village of Kosamghat lying about a mile north of Jubbulpore-Mandla road between the seventh and eighth mile-stones. The two specimens recorded measured 14½ and 13½ inches respectively.

OBITUARY

John William Yerbury

We regret to record the death on November 10 last as the result of being knocked down by a motor car, of Lieut.-Col. J. W. Yerbury, late R.A. Col. Yerbury who was aged eighty at the time of his death, was born on March 30, 1847, at Serampore in Bengal, and was the son of Lieut.-Col. John William Yerbury, of the 3rd King's Own Light Dragoons and afterwards of Belcombe, Bradford-on-Avon. He obtained his commission in the Royal Artillery in 1868 and up to his retirement in 1892, served in various parts of the world. He was for many years stationed at Aden, and from his papers on the Birds of this settlement (which appeared in the *Ibis* for 1886 and the Society's Journal for 1897) he was well-known to ornithologists.

Col. Yerbury was one of the earliest members of the Bombay Natural History Society, being on the rolls in 1886 when the Society issued its first Journal. Besides ornithology, he was keenly interested in Mammals, Reptiles, Lepidoptera and Diptera, of all of which he made considerable collections, especially of the last named which he eventually presented to the British Museum. He also collected shells at Aden, several of which were described by the late E. A. Smith (*Proc. Zool. Soc. London*, June 16, 1891) as new species and named after him. After his retirement his chief interest appears to have been confined to Diptera on which group of insects he wrote several valuable papers.

His most important contributions to the Journal of this Society are as follows :—

'The Butterflies of Aden and Neighbourhood, with Some Notes on Their Habits, Food Plants, etc.,' vol. vii, p. 207.

'A List of the Birds of Aden,' vol. xi, p. 75.

His appeal for assistance in collecting Gad Flies, Bot Flies and Warble Flies (vol. xiii, p. 683) contains some very useful instructions for collecting these insects.

Officers quartered at, and residents residing in Aden have cause to be indebted to the late Col. Yerbury for leaving behind for their use with the Political Resident at Aden, a set of valuable pamphlets on the Flora and Fauna of the settlement 'as complete as I have been able to make it.'

Eugen M. Van Ingen

The death occurred at Mysore on February 27 of Eugen M. Van Ingen the well known sportsman and taxidermist, after a severe operation. Mr. Van Ingen joined the Bombay Natural History Society in 1913 and was known among a very wide circle of

friends, as the very best of good fellows. Mr. Van Ingen's fame as an artist in taxidermy was only equalled by his keenness and proficiency as a shikari and fisherman. Some of the biggest known records in jungle and stream were annexed by him and his advice and assistance were freely sought in big game expeditions organized in the State on the occasion of the visit of distinguished guests, notably the Prince of Wales, the Earl of Reading and H. E. Lord Irwin. His death, which creates a great gap in the personnel of Indian shikar, will be deeply deplored by hosts of sportsmen throughout the country.

MISCELLANEOUS NOTES

I.—THE TRUTH ABOUT 'A UNIQUE LION PHOTOGRAPH'

We are glad to notice that the photograph of a young Lion attacking a Zebra, published on page 583 of this Volume has aroused such considerable interest amongst our readers.

Writing on the 20th of March, Mr. F. W. Champion, the well-known wild animal photographer and author of *With a Camera in Tiger-land*, puts forward a number of well-considered and cogent reasons for his belief that the photograph is one of those ingenious fakes which are unfortunately much too common with Natural History subjects. Quite naturally, however, he could not be altogether certain that it *was* a 'triumph of the faker's art', and admitted that if genuine, it must in his opinion be 'by far the finest natural history photograph ever taken by anyone or likely to be taken.'

Sometime back we had written to Messrs. Hutchinson & Co., the publishers of *Animals of all Countries*, for information regarding the same photograph reproduced in their book, and referred to in the note which accompanied our plate. To this we recently heard from Mr. Wm. Martin-Hurst, Managing Editor of the Exclusive News Agency, London, ('E.N.A.') who kindly wrote to say that he could give us no particulars beyond the fact that their original photograph was a very old copy, having been in their possession for at least 25 years; that as far as he knew it came originally from an American source and was said to have been taken by a well-known American Big Game Hunter; and that various people more or less qualified to speak had cast considerable doubt on the authenticity of the picture.

Still more interesting are the cuttings from *The Camera* for April and June 1927 received by the last mail through the kindness of one of our members, Mr. A. J. Page, which help conclusively to run the photograph to earth. The April (1927) number of *The Camera* in noticing a monthly Magazine of photography issued by the Soviet from Moscow entitled 'Sovietskoe Foto', reproduced from its pages the same Lion-Zebra photo with the following graphic and soul-stirring account: 'One of the pictures which we endeavour to reproduce is without exception the most dramatic and tragic nature picture that we have yet seen. It is said to have been taken by a hunter on the plains (or steppes) of Africa. It shows the triumphal ride of a lioness on the back of a Zebra, terror depicted on the unfortunate animal's features as in vain he flies to escape from the fate that awaits him. It reminds one in its wild way of the triumphal march of an emperor through the streets of Rome celebrating his victory. Nothing was spared to display the barbaric glory of the victor, even to the march of his conquered victim, barefooted and in chains. Here is the Queen of the jungle, emblem of ferocity and cruelty, and it requires no imagination to realize that in an instant



The Clouded Leopard (*Felis nebulosa*). (See Miscellaneous Note No. II)

the Zebra must collapse and that the Lioness's fangs will be in its throat.'

The publication of the Soviet photograph in *The Camera* promptly elicited the following letter to the editor from a good lady in Bakewell, Derbyshire, whose name is not given as the gentleman she refers to (whom we by no means envy!) has quite wisely preferred to remain silent in spite of being addressed on the subject.

'Dear Sir—It may be of interest to you to know that the actual photographer of the incident you reproduce of the Lioness and Zebra, resides here in Bakewell. Having had in my possession a copy of this, I was more than astonished to find it on the front of your magazine when in a Sheffield photo shop last month. I was in conversation with the gentleman only yesterday and he assures me that the incident did really happen as depicted, and that he was a member of the hunting party. It certainly did not happen recently, as he has left South Africa since 1916. How it has got to Soviet Russia has yet to be explained.'

While these amusing and amazing claims and counterclaims were in progress, the matter seems to have been brought to the notice of the 'iconoclastic' Dr. G. Arnold, the Curator and Zoologist of the Natural History Museum, Bulawayo, whose conclusive letter on the subject expresses our sentiments admirably. Dr. Arnold writes under date 29th April 1927:

'Dear Sir—It is quite correct that the photograph on the cover of *The Camera* is taken from part of a group in this Museum. Some years ago a photo was taken of this group, and, with a faked background added, was published in the United States with the information that it was a snapshot taken by an intrepid hunter. 'Liar' would perhaps have been a more correct description of the intrepid gentleman. The photo on the cover is not new to me, as it was published elsewhere some years ago, and broughr to my notice.'

Our thanks are due to those members who have communicated to us their views on the photograph, and helped towards the final elucidation of the mystery.

EDITORS.

II.—A CLOUDED LEOPARD (*FELIS NEBULOSA*) ATTACKING MAN

(With a plate)

I enclose a photograph of an animal which was brought in by a Karen boy who stated that while cutting wood near his village he saw the animal approaching him and when it saw him it crouched and approached him cautiously 'pushing bundles of branches and leaves in front of it.' It sprang at the boy who split its skull with a *dah* (knife). I find on inquiry that this is generally believed to be the usual method this animal adopts when approaching its prey whether as a means of concealment or to puzzle its prey I am unable to say. Perhaps you could enlighten me on this point.

The animal is a species I have never seen or heard of before ; it is known locally as ' In Cha.'

This particular individual is known to have taken several head of cattle in the vicinity.

TAVOY, BURMA, A. BROWNLOW,
December 10, 1927. *Indian Police.*

[The identity of the animal in Mr. Brownlow's note and photograph as the Clouded Leopard (*Felis nebulosa*) is confirmed by the skin sent us for examination. This beautiful and somewhat rare cat inhabits the hilly portions of Burma, Siam, Malay Peninsula, Sumatra, Java and Borneo and also occurs in Assam, Sikkim, Bhutan and the Nepal Himalayas. It attains a length of from 6 to $6\frac{1}{2}$ feet of which $2\frac{1}{2}$ to 3 feet is taken up by the long and thickly furred tail.

Our knowledge of the habits of this animal is very scanty and Mr. Brownlow's note forms an interesting addition. It is believed principally to be an arboreal species feeding on small mammals and birds which it captures among the branches. EDS.]

III.—NOOSING TIGERS

Among the coolies on these hills there has been a custom (which I have strenuously tried to stop) of setting traps and wire nooses for the catching of Sambur, Barking Deer and Pig.

I was informed one day last month that a tiger was heard ' Making plenty big noise ' at a place about four miles from my bungalow. On arriving at the scene I found him to be about 98 per cent dead and proceeded to put him out of his misery.

On examination I found that the tiger had been caught around the neck by a wire noose, presumably placed for the unwary sambur. The wire had been placed across a well-trodden sambur track.

The wire in question had a total length of 10 ft. 7 in. was 5 ply of approximately 20 gauge. The far end was affixed to small sapling, at a height of about 3 ft. from the ground.

The beast was a full grown male, in healthy condition, measuring 9 ft. 8 in.— ' fair do's ' —between pegs.

Last year a similar case occurred on a neighbouring estate, the wire in this instance was ordinary telegraph wire. The beast, I am told, measured, 9 ft. 7 in.

Yet another case occurred last year in which a tigress was noosed, of the particulars of which I am afraid I am ignorant.

How is it that a noose, presumably placed for snaring sambur, will catch a tiger which usually walks, and even stalks with his head down ?

PALAGAPANDY,
NELLIAMPATHIES, H. A. BOAS.
November 22, 1927.

IV.—REPLY TO MR. PHILLIPS' NOTE ON P. 371, VOL. XXXII *RE*-COLOUR OF THE LONG-ARMED SHEATH-TAILED BAT (*TAPHOZOUS LONGIMANUS*)

I am quite in agreement with Mr. Phillips that the young of *T. longimanus* are coloured like the females (and *not* like the males) as is the general rule with all juvenile animals.

It is very apparent that he has confused the statement of Blanford with mine, as will be clearly seen from the paras which I reproduce below :—

Mr. Phillips writes, 'I do not, however, agree with the suggestion that the young of this bat are pale fulvescent and become gradually black with age. I am convinced from my experience (*so am I.*, C. Mc C.) with species in Ceylon, that the opposite is in reality the truth, that is to say, that the young are darker in the first coat and become gradually lighter and more brightly coloured with age, the adult male becoming light reddish (almost cinnamon) brown eventually.'

The following is an extract from *my* note in the Journal vol. xxxi p. 1030 :—

'All the three males were much lighter in colour than the females, being a yellowish-brown : the females on the other hand were dark blackish-brown, almost black. Blanford, in the *Fauna of British India*, mentions that Blyth observed the young individuals to be pale fulvescent and that they become gradually darker with age. Whether these paler ones were males or females he does not say, for they might have all been males. One male taken by me the day before was even paler than those secured in the Museum, being a very pale fulvescent tint.

On looking through the material in the Society's collection I found this difference to be the general rule, only a few being like the females which are probably young specimens. One at least is very young and coloured like the female. In almost all cases I could pick out the males from the females by the difference of colour alone.'

With regard to the question, 'Whether these paler ones . . . . for they might have all been males ?' I doubted Blyth's statement regarding the age of the bats. I did not mean to suggest for a moment that the young were coloured like the males ! It is quite clear from my statements in the second para '. . . only a few being like the females which are probably young specimens,' and 'one at least is very young and is coloured like the female,' that I was of Mr. Phillips' opinion that the young were coloured like the females and not like the males.

BOMBAY, C. McCANN.
January 10, 1928.

V.—HABITS OF THE PORCUPINE

Mr. C. McCann's note on the Habits of the Porcupine in vol. xxxii, No. 1, has somewhat surprised me. Porcupine exist in large numbers on these hills (the Billigirirangans) and it is

very noticeable that not only their little paths, on the hill-sides, but also paths formed by deer and other game are strewn with their droppings but I have never noticed cone-shaped accumulations of their excreta. The little Four-horned Antelope, which has only two horns in these parts, and is known as the *Pokey*, is addicted to this habit and the above is a good description of the little mounds of excreta formed by them: but similar formations in the case of porcupines are not seen here.

HONNAMETTI ESTATE, ATTIKAN P. O. *via Mysore*, *December 11, 1927.*

RALPH C. MORRIS.

VI.—AN ELEPHANT WITH EXTRAORDINARY 'GLANDS'

(*With a plate.*)

In answer to your letter of December 29, regarding the Bellagalla Rogue Elephant which I shot and sent you the snap of, which had two extraordinary glands on the neck, which I thought might be of interest to you, I will briefly give you some particulars which may be of further interest.

This elephant used to frequent the forests between Coimbatore District and Mysore State, adjoining the Billigirirangan Hills. I shot it in the valley about half-way between Attikan and Kollegal.

During the past two years or more, it had become a great menace to the people living in the wilds round about and it took to destroying their crops and no one dared to go anywhere near to drive it away without being chased by it. It made short work of a few unfortunates whom it got hold of and from all accounts it simply trampled them out flat. It was proscribed a rogue about two years back and though many set out after it, they did not have the fortune to meet it. Mr. Ralph Morris of Attikan who I believe is well known to you, promised to send me a wire if any reliable khubber reached him about rogue elephants, of which there were many, making their appearance off and on round about Attikan, and as luck would have it he wired to me on October 24, and I managed to get to him on October 26. We got into touch with the rogue on 29th and after much tracking we came upon him in an opening in the thick jungle, quite suddenly. I feel sure he had his eye on us. He stood quite still about 40 yards off giving us a broadside shot. Morris let me have the shot and I got in a well placed shot between the eye and ear which stunned him and Morris followed up with another shot immediately after and he swung round falling on his side on the slope of the hill as the picture shows and I placed another good shot at the base of the skull which ended his career. It was all over in a minute or so. On going up to him I noticed the two glands (I call them glands but may be I am wrong).

The one you see on the upper side (right) was about 3 to 4 inches long, whereas the one on the underside was quite, 9 inches long. They were both very slimy in appearance and to feel. They were



Mr. A. S. Laurie's Tusker showing the peculiar gland-like growths on neck (X).
Upper 4 inches and lower about 9 inches in length.

coated with a whitish fluid (slime) and seemed to be merely two bags or envelopes, which you could distend, being very elastic. They were black in colour. The lower one looks white due to the sun shining down on it and probably the reflection from the slime causes it to look white in the photo.

The light was very difficult being about 8.45 a.m. and the sun was just peeping over the hill through the thick growth. The photo I send (reproduced herewith) was the best of three snapshots.

By the way I know Mr. Ralph Morris cut off the lower gland with the idea of sending it to you. I do not know if he actually did so for I had to leave hurriedly.

The people of the forests who accompanied us told us that they had never seen any elephant with this extraordinary formation under the neck and I have made enquiries of others who have had a lot to do with elephants and they say the same. It will be interesting to learn if possible what function they could possibly perform.

COIMBATORE, S. INDIA, *January 4, 1928.* A. S. LAURIE.

[Regarding, the above tusker and the extraordinary 'glands' Mr. Ralph C. Morris writes us as follows :—

'I was with Mr. Laurie at the time he shot the elephant and we were both amazed to see, when we went up to the fallen tusker, that it carried a most extraordinary pair of appendages on its neck, one on either side behind the lower jaw-bone as can be clearly seen from the photograph. The appendages were in the shape of sausages, the upper one being about 5 inches long, and the lower a good 9 or 10 inches. To the touch they were tender and appeared to be covered with a skin of unusual thinness, the skin being of a raw appearance, mottled grey-pink in colour and moist. Apart from the fact that the elephant was clearly in "Musth", there being a flow from the "Musth" gland orifices, I cannot think what was the cause of these extraordinary growths, nor can I assign any reason for them. I referred the question to Mr. Saunders, Principal of the Veterinary College in Madras, but Mr. Saunders could advance no theory on the matter. He had seen nothing of the kind before, and although I have been in at the death of eleven or twelve proscribed elephants I have never seen a similar case before, nor have I seen growths of this kind mentioned in any work on elephants. I had the larger of the two appendages cut off and gave instructions for it to be pickled preparatory to sending it to the Madras Veterinary College for examination. Unfortunately my instructions were misunderstood by my skinner who, instead of preserving the whole appendage, skinned it, threw away the inside, and pickled the skin! Can you ascribe any possible reason for these growths, and have you heard of a similar case before?'

Mr. A. J. W. Milroy, I.F.S., of Assam, who has had considerable experience of elephants, both tame and wild, writes to say that he has never come across any glands of this sort.

Mr. N. L. Bor, I.F.S., of Goalpara District, Assam, another authority on elephants writes in this connection as follows :—

'As far as my experience goes I have never seen growths of the type mentioned by your correspondent. Tumours of a fatty or serous nature are not uncommon and I have seen them both in tame and wild elephants. These tumours which are soft and elastic are not infrequently found on the folds of the skin on the neck. Those which are serous in type contain a fluid which is rather slimy and of a barley-water colour.

It seems to me that the growths in question, I do not think they can be glands, are of a similar nature which may have possibly become chronic or malignant.'

It is extremely regrettable that owing to a misunderstanding the contents of the 'glands' should have been lost. It would be interesting to hear what Zoologists have to say about these growths or appendages. Eds.]

VII.—ON 'NATURAL DEATHS' IN WILD ELEPHANTS

With regard to Mr. F. W. Champion's interesting article on 'Wild Elephants in the United Provinces' in vol. xxxii, No. 1, in which he quotes instances of elephants having been found dead, the case of the elephant found dead in the Lansdowne Division certainly seems to be one of death from old age. Is there not just a possibility however that it had been poisoned by villagers? Mr. Champion mentions that the graziers had known the elephant for a year, and that it was too old and weak to run away *with the other wild elephants when driven from the crops of the neighbouring villagers.* This may be so: but I have known of elephants frequently refusing to be driven off from villagers' crops, remaining in cover close to the fields when the rest of the herd had retreated back into the jungles. I once came upon the decomposed carcases of three cow elephants at the foot of these hills. The local forest subordinate informed me that he thought the elephants had probably died of anthrax—though he could advance no evidence in support of his theory: no other elephants had been reported sick or died: nor did I hear of any other deaths. The elephants were lying dead within a few yards of each other. I do not think that the anthrax theory was possible, nor do I consider it at all likely that the elephants had died of natural causes. I was assured later by my trackers, that the ryots in the fields these elephants had been in the habit of visiting and causing considerable damage to, had put out a number of poisoned pumpkins, etc., which these elephants had eaten. Here there was the possible cause of their death. Mr. Champion speaks of the elephant having been moved from its first position. This is quite possible. I have seen a wild elephant trying to move a tusker (a proscribed rogue) I had shot: and in the case of a herd tusker shot by the late Mr. R. H. Morris the carcass was actually shifted a few yards by other elephants of the herd which returned to the spot later. A tusker shot by Mr. A. L. Laurie of Coimbatore in November 1927, when I was with him, on a slope above a stream was moved a few yards down to the edge of the

stream by elephants in a herd which visited the place a day or two later. This elephant was clearly in 'Musth', there being a discharge from the 'Musth' gland orifice between the eye and the ear on either side of the head. It is remarkable how quickly the skeleton of an elephant will disappear, and Mr. Champion in no way exaggerates when he says that 'a single season may easily remove the entire body and much of the skeleton of an animal even as large as an elephant.' A couple of years is sufficient to remove all traces of a dead elephant—except perhaps the skull which may be found hidden away in long grass and dense undergrowth for a year or two longer. Protection has undoubtedly contributed to the increase of elephants in South India. Probably the Kheddas held by the Mysore Government do more than anything else to keep their numbers down in these parts, but even then I consider that elephants are rapidly increasing. When I was in camp last March there were at one time four separate and distinct herds of elephants near our camp and three or four solitaries besides.

I have just received Mr. Champion's book *With a Camera in Tiger Land*. The photos shown of Tiger, Panther, Elephant, Deer, etc., in their natural state are wonderful and the reading enthralling. Mr. Champion writes as only a keen naturalist and lover of jungle and its denizens could write. The photographs are superb, and one can imagine the trouble and painstaking care involved in the achieving of such thrilling results.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
Via Mysore,
December 11, 1927.

RALPH C. MORRIS.

VIII.—CLICKING NOISE MADE BY MUNTJAC

In your issue of August 1, 1927 'Miscellaneous Notes' I have read a note with the above title by Mr. Randolph C. Morris.

I am surprised to learn that Col. Burton has never heard the Muntjac (the Khákar or Barking Deer of Northern India) emit this clicking noise. I spent many years in the forests of the United Provinces, between 1889 and 1918, and very frequently heard the noise described, especially when the Khákar was disturbed at close quarters.

The noise is, as stated by Mr. Morris, only produced as the animal bounds off. I believe it to be restricted to the male only but I cannot be absolutely certain of this.

The noise is a rapidly repeated cluck–cluck–cluck. . . . Generally only six to eight repetitions, and I have always believed to be produced in some way by impact of the animals' teeth. It is far too rapid (about three to the second) to be produced by the feet and as a matter of fact a very similar sound may be produced by striking two pieces of bone together.

B. B. OSMASTON,
Indian Forest Service (Retd.)

IX.—CROWS AND KOELS

M. Jouguet's letter in the number of the Journal published on October 20 last reminds me of an occurrence which came to my notice some three months ago, which may be worthy of note.

Crows having become an insufferable nuisance round the bungalow, I had taken to shooting them, in the forlorn hope of driving them away. As is the way with crows, they had become sufficiently knowing to keep just out of range, and we had reached the stage when, by careful stalking, I occasionally got one which was either too daring or too slow.

One evening, shortly before sundown, this game was in progress, all the birds being between me and the sun, when suddenly there was a loud 'caa' from the far side of a *Derris robusta* tree near by. Looking up, I could just make out a black body through the feathery foliage, and shot it.

On picking up the bird, I was astonished to find that it was a female koel (*Eudynamis scolopaceus malayana*?). It had appeared to be black from being against the sun, and its 'caa' was such a perfect imitation of the real thing that, although I could not make out the shape of the bird, I had had no doubt that it was a crow.

Has this occurrence been recorded before? If so, is the object of it known? Had it been a different time of year one might have supposed that the koel was endeavouring to mix with the crowd to accompany the crows to the roosting place. There was no sign of a male koel, though I watched until the birds began to clear away. Moreover, it is the only time in six years of residence in the bungalow that I have known of a koel anywhere near the compound.

TOCKLAI EXPERIMENTAL STATION,
CINNAMARA P. O. & T. O.
ASSAM,
December 19, 1927.

E. A. ANDREWS,
Entomologist,
Indian Tea Association.

X.—THE RUFOUS-BREASTED BLUE FLYCATCHER (*CYORNIS HYPERYTHRA*) AT HIGH LEVELS

While examining recently the series of *Cyornis hyperythra* (Blyth) belonging to the Bombay Natural History Society's Museum I found two specimens differing markedly from the rest which were in agreement with authors' descriptions: Oates, Baker, etc.

The two skins are generally paler greyer-blue above; much less rufous below and perhaps have more white on the tail than in examples representing the typical race which has Darjiling for type locality. They are also paler and greyer than the south-eastern forms.

One of the birds was taken at 6,000 ft. on Mt. Victoria, Burma, and the other at Dakuri, 10,200 ft., on the Pindar R., north of Almora in Kumaon.

These localities are practically at the extremities of the range of *C. h. hyperythra* so it seems out of the question to regard them as representatives of a distinct race unless that should be a high-level form.

This note is written to suggest that those possessing other high-level specimens should compare them with more topotypical examples.

SINGAPORE, C. BODEN KLOSS.
December 20, 1927.

XI.—THE NIDIFICATION OF THE SIND HILL WARBLER (*SUYA CRINIGERA STRIATULA*).

In the *Fauna of British India*, Birds, Revised Edition, vol. ii, p. 520, the nidification of the Sind Hill Warbler (*Suya crinigera striatula*) is shown as not recorded, and the following note may therefore be of interest.

During the last week of July of this year I found the bird common on the hill of Sakesar, some thirty miles east of the Indus and at the extreme west of the Punjab Salt Range, of which it forms the highest point (4,992 feet).

Its favourite haunts appeared to be steep slopes covered with long grass and well supplied with bushes of various kinds. Nesting operations were in progress and several nests were found, mostly in course of construction.

In one nest a bird was sitting on two eggs on July 24, and again on 28th, when the eggs were taken and the male parent secured. The eggs, which were slightly incubated, have a ground colour of very pale pink and are marked with pale reddish blotches scattered over the whole surface and most numerous at the broader end, where they form an ill-defined ring. The nest was situated, barely twelve inches from the ground, in a 'Sanatha' (*Dodonæa viscosa*) bush, through which some tufts of grass were growing. It was an oval-domed structure, made of strips of grass, and the lower portion was matted with seed-down. The inner lining was of fine grass, and the entrance faced north.

Another nest, similarly built and situated, contained three half-fledged young on July 28.

A small series of the birds was collected and sent to Mr. H. Whistler who kindly identified them.

I have not met with this Warbler in any other part of the Salt Range.

SARGODA, H. W. WAITE, F.Z.S., M.B.O.U.,
PUNJAB, *Indian Police.*
October 15, 1927.

XII.—ON THE UNUSUAL FOOD-HABITS OF HORNBILLS

Apropos the subject of the unusual food-habit of *Dichoceros bicornis*, Linn., as recorded by Mr. W. S. Wood in *J.B.N.H.S.* (vol. xxxvii, page 374) it is worthwhile to cite an instance of the piscivorous habit of *Lophoceros birostris* (Scop.) which came under my personal observation. It was in 1926 when at Hazaribagh I bagged alive a specimen, very slightly injured by my gun-shots. Anxious as I was to keep it in captivity, I was confronted with a vexed problem as to its diet. Knowing it to be a frugivorous bird I tried all sorts of fruits and berries, which I found it, to my amazement, to avoid studiously. It was literally starving itself for a couple of days and would touch nothing except water. When I tried to force a piece of ripe banana down its throat it would simply disgorge the whole thing out. At last when some small fish were presented before it, it readily paid attention to the fry, and after throwing these up one by one in the air, it would catch them in its bill and gulp down. The fact of this bird having any greed for fish has never been recorded anywhere. In this case also the question arises whether it is a practice commonly indulged in by these birds in their wild state or merely a case of individual idiosyncrasy noticeable in captivity. The fish-eating habit has only been observed in the case of *Anthracoceros m. malabaricus* (Gmelin). The other members of the *Bucerotidæ* appear to be largely frugivorous, although a varied menu consisting of smaller reptiles and rodents, snails and various insects is also more or less indulged in. R.B. Sanyal, a former Superintendent of the Calcutta Zoo, prescribed for the captive Hornbills a carnivorous dietary, within which small birds were included (*vide* his Handbook of the management of animals in captivity in Lower Bengal). It is, therefore, easy to realize that with a hungry Hornbill nothing goes amiss provided its size falls within manageable limits. I have even seen *Lophoceros birostris* (Scop.) devouring the petals of *Bauhinia* flowers, which appear to form a major part of the bird's diet in places where there is a comparative dearth of fruit trees and berries. The omnivorous habits of the Hornbills are no doubt responsible for their occasional outbursts of criminality (which finds a full play in captivity when weaker companions are housed with them) but how far the predatory instinct is let loose so as to play its part in Nature's economy is a point which cannot be answered until all the data are available as to the food habits of each species.

CALCUTTA. SATYA CHURN LAW,
M.A., B.L., PH.D., F.Z.S., M.B.O.U.

XIII.—THE BLACK-CAPPED KINGFISHER (*HALCYON PILEATA*) IN THE DARBHANGA DISTRICT, BIHAR

I have on several occasions recorded the occurrence of this bird in Bihar in these pages, most of them being got in February. It is rare but not as rare as I at first took it to be. I now record another which I shot in September.

On the afternoon of September 17, 1922, while out in boat fishing with my brother on the Bhagmati River near Bunhar factory we got within five yards of one of these birds. The river is an open one running through cultivation and the Kingfisher was on a bush overhanging the water. It took absolutely no notice of the many small fish which came to the surface nor of us in the boat till we got within that distance of it; even then it only flew across to the other side of the river. We disturbed it on several occasions and what I noticed most was that it flew off silently on each occasion quite unlike an Indian White-breasted Kingfisher (*Halcyon smyrnensis fusca*) which went off uttering its loud, harsh cry. We came across it again on the 19th, this time seated on the bank and finally I shot it on the 20th. It was silent on all three days so I have never heard its cry. It is easily recognized on the wing by the buffy lower plumage, the upper plumage looks black except when the sun shines on it, then it glistens. The contents of the stomach consisted of a small crab; other specimens examined had fed on fish and beetles. The local *Mirshikars* consider it only an albino of the white breasted species and call it *Ablak Tanki*.

DARJILING,
September 28, 1927. CHAS. M. INGLIS, F.Z.S., F.E.S., M.B.O.U.

XIV.—A QUAIL'S QUEER RETREAT

(Reprinted from the Sunday Times, Johannesburg, Transvaal, November 13, 1927.)

A singular case is reported from Somerset East, C. P. A shearer working at Hope Vale, a farm in the district, was busy on a heavy woolled ram of Messrs. W. G. Jordaan and Sons, when he felt a hard lump in the wool on the belly.

On opening up the fleece he found a live, fully-grown quail!

It is supposed that the bird had crept for shelter into the long wool while the ram was lying down, and had remained there when it was driven to the shearing shed. It is stated that there were several witnesses of the find.

Has anything like this been found elsewhere?

XV.—OCCURRENCE OF THE SHELDRAKE (*TADORNA TADORNA*) IN THE DARBHANGA DISTRICT, BIHAR

There have been notes in late Journals of the occurrence of this duck in various parts of Bihar, so it may perhaps be interesting to gather together data of those got by me; some of these have already been noted by me in this Journal, my first record being in vol. xv, p. 338 of 1903. During that year I got one from Mr. Edgell and another was snared not far from Baghownie. In 1905 I got four specimens, two drakes from the Benoa *chaur* on May 1, and June 5, and two ducks, one on November 6, near Baghownie and the other on the 30th of that month from the Maiser *chaur*. I don't appear to have got any more till 1915 when one was

brought in alive by a *Mirshikar* on July 28. It was in good condition and didn't appear to have been wounded at any time. During the following year I got a fine drake near Baghownie on May 12, with a well developed knob on its bill. It was on a small patch of mud and water, more mud than water. The last record I have is of a duck got at the Benoa *chaur* on June 24, 1923 another late date for it to be found. After that I left the district but have no doubt that had I remained there I would have been able to add to these records. Besides these nine specimens I have also heard of one or two others being shot.

DARJILING,
September 28, 1927. CHAS. M. INGLIS, F.Z.S., F.E.S., M.B.O.U.

XVI.—OCCURRENCE OF THE SHELDRAKE (*TADORNA TADORNA*) IN THE UNITED PROVINCES.

On December 25, 1927 at Saman Jal, Mainpuri District, United Provinces, there were shot two specimens of the Sheldrake (*Tadorna tadorna*).

ROORKEE,
January 4, 1928. E. E. L. SEARIGHT, *Capt.*, R.E.

XVII.—RECOVERY FROM THE BITE OF A PHOORSA (*ECHIS CARINATA.*)

No. 4179383. Fslr. Brannar, 1st Royal Welch Fusiliers, had been employed on fatigue, with other men, in knocking down a wall. The wall had been knocked down and the men were carrying away the stones. Brannar lifted up a large stone and was bitten by the snake, which was underneath. This was at 5.10 p.m. on October 4, 1927. He reached hospital about 5.30. There were two well-defined punctures on the dorsum of the terminal phalanx of the right middle finger, which were slightly oozing. The orderly assistant surgeon incised them and rubbed in permanganate crystals. He was seen by the orderly officer about twenty minutes later and was given 40 c. c. of antivenin serum, subcutaneously, in the flank. He did not show the faintest trace of constitutional disturbance. He showed us a small gland in his right axilla, and said that he felt a slight tingling running up from the finger to the gland, and added that the tingling was not painful. He was detained for 36 hours, and then discharged to 'attend'. I saw him, this morning. He assured me that he had not felt the slightest ill-effects, at any time, and he is an intelligent man. There was slight thickening over the incisions, and one was oozing a trace of serum. The finger was not painful.

The stone had already been disturbed with a crow-bar, before Brannar picked it up. It seems to me that the absence of all signs of poisoning may be due to the snake having struck at the crow-bar and emptied its poison sacs, before Brannar lifted the stone.

British Military Hospital,
Nasirabad,
October 9, 1927.

A. A. MEADEN,
Lt.-Col., R.A.M.C.

[The snake that bit Fslr. Brannar has since been sent to us and identified as the Phoorsa (*Echis carinata*). We append a note on the subject of Indian snake venoms by Lt.-Col. F. P. Mackie, I.M.S., Director of the Haffkine Institute, Bombay, which is of great interest. He writes :—

'The mortality from snake bite in India is due in the large majority of cases to one of four species. The cobra and the krait which are known as colubrine snakes, and the Russell's viper and the *Echis* (or phoorsa) which are viperine.

The poison of colubrine snakes affects chiefly the nervous system and produces paralysis of various muscles, staggering gait or incoordination of speech followed by respiratory paralysis, convulsions and death by respiratory failure. The symptoms of viperine poison are severe and persistent pain at the position of the bite and oozing of blood from the punctures. Death may take place from paralysis of the heart or from clotting of blood in the vessels if the dose is large or is injected into a vein but if life is prolonged hæmorrhages take place from the mouth, nose or intestines or in various part of the body. Mortification and gangrene occur at the site of the fang marks and the finger or hand may be lost in this way even after the general symptoms have passed off.

The minimum fatal dose of cobra venom is about 15 milligrams (about 1/5th grain) and the snake gives from 5–10 lethal doses at one bite. The krait can deliver five times the lethal dose and the Russell's viper and Echis about twice the lethal dose at one bite. The Echis however rarely gives a sufficient dose to kill an adult man.

Death from a cobra bite has occurred in as short a time as 20 minutes, but may be delayed as long as 30 hours.

The antivenine produced at Kasauli is made from the venoms of cobras and Russell's vipers which are collected at the Haffkine Institute and as these poisons are absolutely specific in their action the antivenine is quite useless against the bites of kraits and phoorsas.

Antivenine should always be given into the veins and not under the skin and if given in the following doses will be instrumental in saving many lives especially if given within a short time of the bite :—

Russell's viper bites	80–160 cc. of antivenine
Cobra bites	100–400 cc. ,, ,,

(*Acton & Knowles*)

Permanganate of potash has little or no effect if rubbed into the bite but generally increases the amount of necrosis and tissue destruction.' Eds.]

XVIII.—THE MOGUL EMPERORS OF INDIA AS NATURALISTS AND SPORTSMEN.

(*Published with the permission of the Director, Zoological Survey of India*).

Mr. Salim A. Ali has done a great service to science in bringing together all references to animals contained in the works of the Mogul Emperors of India and in arranging them in a systematic way. No. 2 of volume xxxii of the *Journal of the Bombay Natural History Society* recently published, contains an account of fishes (pp. 268, 269) as described by these emperors. The descriptions are in almost all cases sufficient to enable the animals to be identified fairly closely. Mr. Ali has, however, not been able to do full justice to these descriptions in his interpretations and I therefore propose to add a few comments to the various passages quoted by Mr. Ali.

Babur refers to the fish of India as follows: 'Their flesh is delicate and they have few small bones. They are surprisingly active. On one occasion a net was laid in the river from side to side. Each side of the net was then raised a *gaz* (2½ feet) above the water, yet many of the fish leaped one after the other a full *gaz* over the net and escaped. There are besides in many rivers of Hindustan small fishes which if they hear a harsh sound or the treading of a foot instantly leap a *gaz* or a *gaz* and a half out of the water.'

There is no doubt that in the description of the flesh a reference is made to our larger marketable fish such as *Labeo rohita*, *Catla catla*, *Cirrhina mrigala*, *Barbus tor*, etc. The active species referred to as leaping is probably *Catla catla* (Ham. Buch.). Buchanan Hamilton writes about this fish as follows: 'It is a very strong active animal, and often leaps over the seine of the fishermen, on which account, when fishing for the *catla*, they usually follow the net in canoes, and make a noise by shouting and splashing with their paddles.'[1] I watched big specimens of *catla* leaping over nets at Niazbeg near Lahore in 1919. It is a common sight in Bengal (probably in other parts of India also) to see small fish leaping about on the surface of the water during a heavy rainfall, probably they react to the noise or disturbance produced by the falling rain. These small fish are usually the young of the species enumerated above.

Another reference in Babur's account runs as follows: 'One fish is the *kakeh*. On a line with its two ears issue two bones, three fingers-breadth in length. When caught it shakes these two bones which return a singular sound, whence they have given this fish its name of *kakeh*.' About the identity of this fish Mr. Ali remarks, 'The identity of a fish described by Babur in the following terms is a mystery. Sir Lucas King has made no comment on it, and it is surprising that such a singular animal, if it exists, should not be generally known. I can find no reference to anything like it in Annandale's paper either.' I have, however, no hesitation in stating that this mysterious creature is *Rita rita* (Ham. Buch.), which

[1] Day, *Fishes of India*, p. 553 (1878).

is a common fish at Lahore in winter and is called *Khagga*. One often hears hawkers in the streets selling *Ravi dé Khagge* (*Khagga* fish of the Ravi River). In a collection of drawings by Sir Alexander Burnes made during his expedition to Cabul in 1837–38 and recently described by me in the *Journal of the Asiatic Society of Bengal* I[1] find that this fish is called *Kagá* at Hyderabad and there seems to be no doubt that *Kakeh* is the same as *Kagá*. Moreover, the structure and the habit described by Babur exactly tally with those of *Rita rita*. In this species the pectoral fins are provided with very strong spines which are denticulated at both edges. They correspond to the two bones described by Babur and their length would depend on the size of the fish examined. These pectoral spines along with the powerful dorsal spine are used as organs of offence and defence and it is well known that the jagged spines of some of our Siluroids (cat-fishes) occasion intense inflammation and sometimes inflict dangerous wounds. During the winter season the individuals of this species hide themselves among pebbles and rocks in crevices and lie in such situations more or less in a state of torpor. At this season they are usually caught in great numbers by hand by diving to their places of retreat and holding them, when caught, in such a position that they are unable to move their spines. This is accomplished by holding the fish between the fingers in such a way that all the three spines stand erect. The spines of the cat-fishes are very much feared and they are broken off as soon as the fish are caught.

At Lahore *Rita rita* is sometimes called *Trikanda*, in which reference is made to the three spines of the fish and in the vernacular name *Khagga* I believe reference is made to the jagged condition of the spine, because the thorny budding leaf of the date-palm tree is also called *Khagga*, at least in the Gujranwala District of the Punjab. The dialect changes from district to district in the Punjab and I know that in this part of India the fishermen are often unable to explain the meanings of the vernacular names of fish.

The pectoral spines of *Rita rita* are provided with a set of very strong muscles and their proximal ends are specially modified to form a movable joint with the pectoral girdle.[2] When the fish vigorously shakes its pectoral spines, on being annoyed, a peculiar noise is produced by the movements of the condyles of the spines in the articular grooves. These facts are closely in accord with Babur's description of *Kakeh*.

The *Pulwah* of Sind is now called *Hilsa ilisha* and not *Clupea ilisha*. Mr. Ali observes that this species 'regularly ascends the Indus in February and March in enormous swarms for the purpose of spawning.' While travelling in the Punjab in 1926 I was informed by a reliable authority that these fish do not ascend in the Indus to the distance and in the quantities which are referred to in earlier records, and he actually feared that this highly-prized fish of Sind was in the process of abandoning the Indus altogether. Exact information on this point will be of immense economic importance.

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[1] Hora, *Journ. As. Soc. Bengal* (n.s.) vol. xxii, p. 123 (1927).
[2] Hora, *Rec. Ind. Mus.*, vol. xxii, p. 30 (1921).

Jehangir's reference to the blind fishes of Andha Nag in Kashmir is very interesting. I do not know of blind fish from the freshwaters of India and it is to be hoped that any one who finds them in Kashmir or elsewhere in India will send them to the Indian Museum, Calcutta, for determination.

Jehangir mentions that, 'The best fish in Hindustan is the *Rohu* and after that the *Barin*. Both have scales and in appearance and shape are like each other. Everyone cannot at once distinguish between them. The difference in their flesh also is very small but the connoiseur discovers that the flesh of *Rohu* is rather more agreeable of the two.' Mr. Ali identifies *Rohu* as *Labeo calbasu* and suggests that the other may be the Indian Trout (*Barilius bola*).

Rohu is a name which is sometimes indiscriminately applied to the larger species of carp inhabiting our rivers, these may be *Labeo* or *Barbus*. I find (Hora, 1927, p. 124) that at Peshawar *Rohoo* is applied to a species of *Labeo* probably *dyocheilus* (McClell.) and at Hasan Abdal *Rūhu* is used for a species of *Barbus*, probably *tor*. Elsewhere in northern India and in the provinces of Bengal, Assam and Bihar and Orissa *Rohu* is used for *Labeo rohita* and to the best of my knowledge is never used for *Labeo calbasu*, which on account of its characteristic black colour is known as *Kalabasu* in Bengal. In the Punjab and Sind it is called *Di* and *Di-hee* respectively. *Rohu* (*Labeo rohita*) is considered to be a great delicacy and the Emperor Jehangir in all probability refers to this fish.

The vernacular name *Barin* is new to me and it is only by a process of elimination that I can identify it as *Cirrhina mrigala*. There are four scaly fishes in the Indian rivers that are highly prized for the flavour of their flesh and which grow to a fairly large size e.g., *Labeo rohita*, *Catla catla*, *Cirrhina mrigala* and *Barbus tor*. *Catla* can be readily distinguished by its characteristic upturned mouth. Connoiseurs always find that the flesh of *Barbus tor* is much better than of any other fresh water fish of India and moreover the form of *Barbus tor* is not as deep as that of *Labeo rohita* and the two can also be distinguished by the form of their heads. *Cirrhina mrigala* is very much like a *Labeo* and one is likely to be confused by the two forms; so it is probable that *Barin* refers to *Cirrhina mrigala*. It could have no reference to the Indian Trout (*Barilius bola*) which in its characteristic shape, markings and the position of the fins, etc., is quite distinct from any species of *Labeo* or the other carp named above.

There is no doubt that the Mogul Emperors of India (Babur and Jehangir) were careful students of nature and the descriptions of the animals that they have left behind them, though meagre, fully testify to this. I hope students interested in other groups of animals will further elucidate the facts so ably brought to light by Mr. Salim A. Ali.

ZOOLOGICAL DEPARTMENT,
UNIVERSITY OF EDINBURGH,
December 24, 1927.

SUNDER LAL HORA,
D.SC., F.L.S., F.Z.S.,
Zoological Survey of India, Calcutta.

XIX.—THE EFFECTS OF BEE VENOM

Reprinted from 'The Indian Medical Gazette,' Vol. LXII No. 5, May 1927

Under the above title Dr. A. R. D'Abreau has an article in the *Indian Medical Gazette* for November 1926, and as a few very striking cases have come under my personal observation, I am publishing this note.

The species generally credited with evil effects is *Apis mellifica*. L. Brant and Ratzeburg were the first to study bee venom in 1833. Paul Bert in 1865 and Carlet in 1884 also studied it, but it was not till 1897 that the chemical nature of the poison was carefully studied by Langer.

This poison when freshly extracted is a transparent acid fluid with a bitter taste and an aromatic smell. The acid reaction is believed to be due to formic acid.

Langer's experiments show that the active principle is not an albuminous but an organic base.

The poison is destroyed, or its activity lessened by the action of oxidizing agents.

Castellani and Chalmers (2nd edition) write 'Intravenous injections into dogs produce convulsions, trismus, nystagmus, emprosthotonus, death from respiratory failure. This action is believed by some authors to be due to a neuro toxin, but the blood after death is very fluid, and the red corpuscles are destroyed, indicating a marked hæmolysis, while all the organs except the spleen show hæmorrhage and hyperæmia, so that the effect may not be due so much to the action on the nervous system, as to that on the blood. With regard to the hæmolytic action Morgenroth and Capri have shown that there is a similarity between this poison and cobra venom.'

The constituents of this poison are :—

1. An inflammatory poison, said to be derived from the acid gland.
2. Neurotoxins ; (*a*) convulsive, (said to be derived from the alkaline gland) ; (*b*) narcotic (secreted by the acid gland).
3. Hæmolysins.

Let us now for a moment study the poison apparatus of a bee.

From the posterior end of the abdominal segment projects a chitinous sheath which contains two barbed darts which form the sting. Into this sheath and connected with the darts two (sometimes three) ducts from glands open. The principal duct belongs to the acid gland and opens anteriorly into a sac which is a reservoir for the poison and which leads to a slender coiled tubular gland which may be bifid or even divided into three. This is a very long gland ramifying amongst the contents of the abdomen. The second opening belongs to a small irregular tubular gland called the alkaline gland, or gland of Dufour.

Now bearing in mind that different trains of symptoms are caused as the result of stings, I think it is safe to infer that the two darts can be used independently of one another. When on the other hand a bee is very angry and attacks with force, both darts are used

and the full amount of poison possible for ejection is injected. It should also be remembered (at least this is my idea), that all the bees which apparently attack one do not sting, but the majority generally settle for a second or so and then fly off.

The following cases will I hope illustrate my points :—

Case 1.—In September last an elderly woman in the female ward was stung by a bee at the external canthus of the left eye one afternoon. The Sub-Assistant Surgeon who happened to be in the ward at the time reported that the bee deliberately attacked this patient and would not be driven away until it had stung her. In about an hour's time there was a considerable amount of swelling and ecchymosis over the forehead, left temple, left side of the face, and both eyelids were puffy. At first sight the patient presented the appearance of erysipelas. There was a great deal of pain, a rise of temperature to 101°F. and pulse of 112 per minute. By next morning all the physical signs had greatly diminished and by evening there was no need to consider this part of the patient's illness.

Case 2.—A few days after this occurrence, my wife, son and myself were sitting in the garden, when my son was stung on the back of the neck ; but all that happened in his case was the formation of a little lump (nodule) and a slight red blush about 2 inches in circumference, and this all disappeared in a couple of hours.

This bee did not make a determined attack.

Case 3.—In December 1917 when we were encamped on the Rouvouma River in Portuguese East Africa, a swarm of bees one morning attacked the camp, and 'M', a young chemist who had only recently joined us as a dispenser from Scotland, was most furiously set upon. Some hundreds of bees at a time settled on his head, face, neck, and hands. He became frantic in his endeavours to drive them off and in fact, fright and pain were soon followed by exhaustion, and later on by a good deal of collapse.

In about 3 or 4 minutes the bees had all flown away, and then we extracted about 40 or 50 stings from 'M' mostly from the back of the neck. The face, neck and scalp soon became very red and swollen, and later on a slight œdema was noticed.

This stinging had taken place at 9 a.m. and by 2 p.m. 'M' had temperature of 102°F. and complained of a constricted feeling in the head. During the day he had one or two loose stools, which I attributed to fright as he was a very nervous man. Next morning he felt a 'bit cheap', the neck still showed a slight swelling, but by evening this had gone and he felt quite fit.

Judging from the number of bees that settled on this man, the number of broken stings we found, his method of knocking them off and, finally, the symptoms of poisoning he exhibited, I do not believe that less than one-eighth or more of the bees that settled on him, stung him.

I had often been told that if a swarm of bees are around and you happen to be their line of flight just stand perfectly still and quiet and they will not attack, while the moment you start driving them off by swinging your arms about, the stinging begins, and this was amply proved in this instance. I was not more than four yards away from 'M' when the bees were flying past and I just shouted out to him to keep still and then remained quiet and motionless. Innumerable bees came around me and some actually settled on me and though the temptation to drive them off was great, I did not do so but waited for them to go off on their own, while 'M' on the other hand completely lost his head, with the result that the bees soon concentrated all their energies on him.

Case 4.—Another instance occurred one afternoon under the Kosi Bridge, a few miles out of Kursala in the Bhagalpore District in January 1919. A party of us were in butts scattered along a wide strip of sand awaiting the return of demoiselle cranes from the fields. No one had informed us that there was a huge beehive under the bridge, and 'K' of the Police had his butt not more than 30 yards away from this. As the cranes came sailing past a regular *feu de joie* started but very soon gave place to most awful yells from 'K'. He was soon racing across the strip of sand to the river with a thick swarm of bees about, around, and behind him. Seeing his plight, one of the party to divert the attention of the bees fired a charge of small shot into them and at the same time got his gun boy to throw as much sand as possible into the air about 10 or

15 yards away from him. I do not know the virtue of this procedure but it certainly had the desired effect, for almost immediately the bees left him and flew back to the hive.

Now comes the interesting point. 'K' had one sting on the forehead but from the back of the neck to over the occipital region he must have had fifty or more (I am writing from memory).

The back of the neck is for some reason a specially selected site for stinging. It may be that when attacked one 'ducks' one's head to protect the face and eyes, but this by no means affords a full explanation.

The tsetse fly also selects the back of the neck and the popliteal space.

'K' complained of a burning sensation and a certain degree of vertigo. In a short time the affected area was swollen, red and hot, but 'K' was as hard as nails and no further symptoms developed.

PORT BLAIR,
May 5, 1927.

A. BAYLEY DE CASTRO,
Junior Medical Officer.

XX.—PLANTS AND INSECTS

Jane Austen in one of her novels released a simple but effective thought by making one of the characters exclaim: 'And now you love a hyacinth, so much the better, you have gained a new source of enjoyment, and it is as well to have as many holds upon happiness as possible.' In other words the observation of the symbiosis or close relationship between insects and plants and the place of a plant in its natural classification may sometimes be at once inferred by the insects who are its guests. Thus a beautiful golden green shield bug (Chrysocoris) in Southern India is frequently seen on the leaves of *Jatropha curchas* and in Calcutta a brilliantly coloured bug of the same genus is found on the leaves of *Acalypha indica* also a plant of the Euphorbiaciæ. Sometimes an interesting phenemenon of insect life is witnessed and related by a lucky observer in vivid, impressionistic prose leaving his readers in the dark as to the true identity of the objects described unless gifted with the powers of observation of a Sherlock Holmes.

Extracts in illustration will be quoted in full from their exceptional interest for the guidance of others in the future who have the opportunity of observing similar phenomena in Indian insect life in the localities referred to by the writers quoted. Mark Thornhill in *Haunts and Hobbies of an Indian Official* remarks, 'There are in India many varieties of insects that when they place themselves in certain positions on plants or shrubs appear to be part of the vegetation. Many of them have been described but to realize their wonder they must be seen—one moment a twig, a leaf, or a flower the next moment a moth or a grasshopper. The most marvellous of these transformations that I ever beheld was at the commencement of the ascent from the valley of the Dun to Mussoorie. The lowest part of the road is exceedingly bare, hot and dusty. Along its outer edge there grew a row of extremely small shrubs hardly much more than half a yard in height. The shrubs were always covered with a profusion of white flowers much resembling 'immortelles'. In appearance they seemed as hard and dry as the road itself. I had often noticed these flowers and one day I enquired of my servant what was the name of these flowers and where else they grew for I had never seen any exactly like them before. The man looked surprised at my question and enquired what flowers I referred to, for

he added there were none there. I pointed to the shrubs. He smiled, walked to one of them and touched it with his stick. Instantly the flowers vanished. I saw a tuft of bare twigs, and the air was filled with a perfect cloud of small white moths. They flitted about for a time and gradually alighted and the twigs were covered with white flowers as before.' No doubt Thornhill when he wrote these lines fancied what he saw to be a case of protective insect mimicry but it is a characteristic of some members of the order Rhynchota (which includes the cicadas, lantern-flies, the quaint little-horned monsters known as Membracids, and other small moth-like forms) to collect in gregarious patches on the surface of the epidermis of the plant selected as a host and whose life juice they are tapping and the insects seen by Thornhill were not moths but *Lawana conspursa*. The specific scientific name a 'scattering together' is very apt from the simultaneous fight of the insects when suddenly disturbed. The familiar brown mango-hopper has a similar habit of sudden dispersion when rudely disturbed on mango leaves. The host plant was probably *Plectranthus terni-folius* or *rugosus*, a small shrub of the order Labiatæ common on base hill sides. The leafless condition of the twigs indicated the sapping of the plants by their insect guests. Tragic indeed was the drama of insect life on a species of wild caper (either *Capparis aphylla* or *spinosa*) witnessed by the eyes of Phil Robinson in the vicinity of Delhi and graphically described by him in the following words: 'Everyone has read of the great flights of butterflies that have astonished travellers. Great flights that cloud the sun as they pass overhead, that drive their way even against the wind and do not hesitate at the ocean itself. Right out in the ocean these flights of suicides are sometimes met with, but whence and whither they come and go men of science cannot tell. Now at the foot of the gate-way near the Kutab-Minar, eleven miles from Delhi grows in profusion a thorny shrub, the same that amuses the camels and goats among the ruins of the Futtehpur Sikri Hill, and on the particular morning we were there the whole thicket was alive with white butterflies. I went down to examine it, and such a sight I never saw before. Each bush was alive with the insect in every stage, the chrysalides were so thick in places that they touched each other, and while I watched they hatched by scores and hundreds. I picked a spray of them, and in half an hour the wings were strong and the butterflies were flown. In my hands there remained a twig with a dozen empty shells. This multiplication of life was simply awful. Every other leaf had a caterpillar feeding on it, and among the caterpillars the mothers of the next generation were busy laying their eggs. The bushes were literally alive. And not a butterfly left the place of its birth. As soon as its wings were strong enough to carry it, it hovered about the shell it had just left, and in a minute or two found its mate and thus all on one inch of a twig the life was lived from egg to caterpillar, from caterpillar to chrysalid, and from chrysalid to butterfly. Death was all prepared for them by the side of their cradles. Noticing that in very many cases the butterflies did not move when I came near I picked up one with my hand from the spot on which it seemed to be resting, and then I discovered

the horrible secret of its apathy. A spider was holding it to the branch—a beautiful pale green spider—and my eyes opened. I soon became aware of the multitudes of the same kind that swarmed among the butterflies. I waved my hand over a bush. A hundred butterflies might rise from a branch but a hundred would remain motionless. A spider had hold of each. To give you an idea of the enormous creation and destruction that was going on in this patch of scrub that morning I saw what I mistook for a birds' nest, a globular mass of web pendant from a twig. On taking it off I found it was only the web of a common spider and that it weighed as nearly as possible half a pound. It was all dust and spider's web and dead butterflies. And you may calculate if you like how many dead and sucked-up butterflies go to make up half a pound. Again in a corner just as you have seen dried leaves drifted together by the wind, I saw and sifted with my hands a thick drift of butterflies' wings. There were the remains of tens of thousands.' The butterfly observed by Robinson was *Anaphæis mesentina* or a closely allied pierid. In Western India it is partial to fluttering among the showy white and canary yellow flowers of *Capparis zeylanica*, a habit of which the tree lizard, popularly known as a blood-sucker, is aware. This lizard *Calotes versicolor* lies in wait on the leafy twigs of the plant on the look-out for unwary insects. The lower surface of the hind wings of Anaphæis are sometimes of a yellow tinge. It is perhaps noteworthy that the two lower petals of *Capparis zeylanica* flowers are also yellow and this blending of colours in flower and butterfly must be of a protective nature to an insect poised with closed wings on the corolla of a flower. The green crab-spiders of the genus Thamisus are perhaps far more deadly enemies to lepidopterine life than lizards or birds. From their cryptic colouring they are difficult to discern either on or in the axils of leaves and sometimes mixed up with the bracts or involucre surrounding a cluster of flowers. On one occasion a beautiful day-flying humming bird moth (*Cephanodes hylas*) was observed hanging by its long haustellum (proboscis) from the leaf bracts surrrounding the flower head of a common garden Zinnea. Closer examination revealed the anterior end of the moth's proboscis in the clutches of a green crab-spider snugly ensconced within the flowery receptacle. Humming bird moths are fond of hovering over the blue flowers of *Duranta plumieri* and it was decidedly unusual for one to have fallen a victim at the shrine of a Zinnea. There is also a pale sickly white form of the crab-spider just referred to whose get-up must assimilate with the leaves of the white floretted Zinnea and thus render it just as deadly as the green form just referred to. These spiders are in fact good instances of what is known as ' aggressive protective mimicry.' Their colouring likewise protects them from the attacks of their deadly enemies the graceful restless wasps of the family Pompilidæ who are perpetually on the look-out for spiders and penetrate the inmost recesses of plants in eager quest for their juicy fat-bodied victims.

Y. M. C. A., H. JOUGUET.
WODEHOUSE ROAD.

XXI.—WEEDS OF THE INDIAN WAYSIDE

To most minds the vegetable organism known as a weed is like the scientific definition of dirt—' matter in the wrong place ' when it obtains a footing in some garden and then over-runs the surrounding country, which it may or may not beautify according to a human standard of æsthetics. But it is in the nature of a weed to grow where it is not wanted. Each of the three great sea-port towns of India has imported its own particular weed. In the swampy country of Calcutta, Assam, and Eastern Bengal it is the lovely flowered water-hyacinth (*Eicharnia crassipies*), that has obtained a firm footing, in Madras *Gamphrena decumbens* is dominant, and in Bombay a species of mallow (*Malachra rotundifolia*). The first named, the water hyacinth, has been met with in Madras growing in sparse patches in pools of stagnant water in the Spur Tank and at Perambur near the large local workshops of that town. On one occasion it choked up the waters of a small tank in the suburb of Royapettah. The water hyacinth grows profusely along the banks of the beautiful Ulsoor Lake in Bangalore where however it is being eradicated, and as regards Bombay it has been seen flourishing in the waters of an old tank on the right hand side of the road from Mora to Uran also in another tank behind the southern slope of the lesser Karanja Hill across the harbour of Bombay. On the whole it does best in Bengal although it is one of those weeds which would spread anywhere where there is a sufficiency of shallow water to enable it to thrive and propagate. So far as is known the only insects that visit the thick clustering flowers are flies and small bees. Butterflies however sometimes visit the blue florets of *Monocharia hastæfolia* but none have so far been seen settling on the far more conspicuous flowers of the water hyacinth. Florets or minute flowers are more to the taste of butterflies, and it must be assumed in the case of the water hyacinth that fertilization is effected through the agency of flies and small bees. Although so frequently referred to in the papers as the pest known as the lilac devil and in measures proposed for its eradication on the waters of districts where it has become a rampant weed, there is strange to say no descriptive account of the plant in any of the older hand-books on Indian botany, a sure indication of its recent introduction into India by some enthusiastic horticulturist who imported the plant on account of the beauty of its flowers (and in Calcutta the water hyacinth is sometimes sold as an orchid by wily Indian plant vendors to those who are not acquainted with its history !) Once seen it is an easy plant to identify. Great rosettes of leaves, growing thickly in shallow water shaped like the heads of rampant green cobras from which is thrown out a flowering stem of about a foot in height enveloped in light lilac blue flowers each flower bearing on the inner side of one of the petals a pollen-yellow hieroglyphic in shape not unlike the head of a spear, can be none other but the famous water hyacinth. The buoyant freely floating bladder-like central root-stalk of the plant fixes itself to the muddy bottom of a tank by numerous hair-like roots which when dried look not unlike dense and clotted masses of course human hair intermixed with the remains of this weed when uprooted and

carelessly thrown on the bank of a tank whose surface is being cleared of the pest. It does not appear so far to have been recorded from Northern India.

On alighting at the railway Central Station at Madras and taking a walk in the grounds of the adjoining Peoples' Park, it is at once noticed that large spaces of waste ground are overrun by an insignificant weed of about from 6 inches to a foot in height. The leaves of the plant are of a narrow elliptical contour and of a downy or cottony whiteness on the lower surface, the inflorescence being a terminal white cone-shaped tuft of minute florets. This is *Gomphrena decumbens*, a member of the same genus as the showy purplish-red flowering *G. globosa*, the globe amaranth of gardens. It is pretty evident that the former must have been accidentally introduced into India from its native land Mexico. It is said that the little weed came to India in a round about way from Australia through being included in the fodder grasses loaded on boats conveying horses from some Australian port to India and that it has only established itself at Madras within the last forty years. Nobody seems to know much about it and it is undoubtedly of recent introduction as it has not yet found its way into the pages of Indian botanical handbooks. It occurs but sparingly in Bangalore, where on the other hand another South American weed may be noticed named *Alternanthera echinata*. Creeping along some of the roadsides with leaves of a rounded oval shape and throwing out a spiny inflorescence between the axils which gives it its specific hedge-hog name. De Candolle pithily includes it in his Prodromus under a list of species 'non satisnotæ', but one would like to know something about a plant whose native home is the Argentine Republic that is found straggling about roadsides in Bangalore and Madras. It is of course undoubtedly of accidental introduction having been shipped along with more showy consignments of foreign plants.

Malachra rotundifolia is presumably the large rough-leaved mallow bearing conspicuous yellow flowers growing in dense gregarious patches on low waste lands in and around Bombay. Sometimes white flowers are seen amongst those of normal yellow but the latter it may be added are invariably white inside the base of the corolla of the flower which probably in an unsatisfactory way accounts for the tendency towards albinism in some of the flowers of the plant; Nairne in his flowering plants of Western India gives the impression that the flowers grow in dense heads. It is true that the involucre of three reniform leaves surround a capitulum of five or six sessile flower heads, but of these only one or at most two burst into bloom within the same involucre. In favourable situations this plant if not too crowded will attain a height of four feet, but if growing closely together in dense patches it seldom exceeds a stature of more than two feet. The flowers are visited by butterflies and blue carpenter bees, of the former the species noticed were the Sulphur Yellow, *Terias hecabe*, small blues (family Lycænidæ), the cosmopolitan Painted Lady (*Vanessa cardui*), the green Swallow Tail (*Papilio agamemnon*), and examples of *Papilio aristolochiæ* were observed flying over waste lands where *Malachra rotundifolia* was growing profusely.

The weedy shrubs known as *Lantanas* (family *Verbenaceæ*), now growing wild in most parts of India are also of South American origin. They are easily recognizable from their small white, pink, red and orange coloured florets which grow in dense clusters and which are so attractive to butterflies. There was a spot on the Cooum River at Madras where its banks were over-run with a white and pink flowering *Lantana camara* and on fine mornings these shrubs were visited by scores of fine Trojan butterflies (*Papilio hector*). It was noticed that these insects were flying in a due north to south direction during the months of September and October and some assisted by a favourable following wind must have travelled a good way following the contour of the east coast. The larvæ of this butterfly have been procured at Sivachellum, one of the high peaks overlooking Waltair about 400 miles to the north of Madras. When crossing over from Ceylon to India, this butterfly was extremely common in the adjacent country beyond Dhunoshkodi and Paumbaum. It is also a common Ceylon butterfly. In Bombay the common Lantana is the orange and yellow flowering variety which does not attract as many butterflies as the white and pink flowering form at Madras. Have then butterflies a colour preference sense? It is hard to say. Fritz Muller noticed in South America a Lantana with florets of changeable colour which was attractive to butterflies. He observed that each kind of butterfly was very partial to a particular colour shade in the florets which changed from yellow to orange and from orange to purple in all three stages of colouring. Of course it must be borne in mind that he observed insects and plants in their original natural home. In India the Lantana has been introduced and it can only be asserted with doubtful certainty that butterflies prefer the white and pink flowering form.

H. JOUGUET.

Y.M.C.A.,
WODEHOUSE ROAD.

PROCEEDINGS

Annual General Meeting

The Annual General Meeting of the members of the Bombay Natural History Society was held on Wednesday, February 29, at 6 p.m., in the Prince of Wales Museum with Mr. H. A. W. Brent in the chair.

The Honorary Secretary announced thirty-one new members since the last meeting.

The appointment of officers for the ensuing year was as follows :—

President : H. E. The Right Hon'ble Lt.-Col. Sir Leslie Wilson, P.C., G.C.I.E., C.M.G., D.S.O.

Vice-Presidents : H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E. ; Revd. E. Blatter, S.J., Ph. D., F.L.S., and the Hon'ble Mr. J. E. B. Hotson, C.S.I., O.B.E., I.C.S.

Executive Committee—Bombay : Mr. R. D. Bell, C.I.E., I.C.S. ; Mr. A. M. Clarke ; Sir Currimbhoy Ebrahim, Bart. ; Mr. Alwyn Ezra, F.R.G.S., F.R.C.I., F.Z.S. ; Prof. V. N. Hate, B.Sc. ; Lt.-Col. F. P. Mackie, I.M.S. ; Mr. P. M. D. Sanderson, F.Z.S. ; Mr. A. Todd ; Mr. J. B. Greaves (*Honorary Treasurer*) and Sir Reginald A. Spence, Kt. (*Honorary Secretary*).

Advisory Committee—Moffusil.—Mr. T. Bainbrigge Fletcher, F.E.S. (Pusa) ; Mr. T. R. Bell, C.I.E., I.F.S. (Retd.) (Karwar) ; Col. W. H. Evans, C.I.E., R.E (Peshawar) ; Lt.-Col. F. C. Fraser, I.M.S. (Waltair) ; Dr. F. H. Gravely, D. Sc. (Madras) ; Mr. C. M. Inglis, M.B.O.U., C.M.Z.S. (Darjeeling) ; Lt.-Col. C. H. Stockley, D.S.O., M.C., O.B.E. (Jhansi) ; Lt.-Col. R. B. Seymour-Sewell, I.M.S. (Calcutta).

The Honorary Treasurer's Report

The Honorary Treasurer, Mr. J. B. Greaves, presented the audited accounts for the past year for the approval of members and in a brief explanation stated :—

' You will notice that this year in addition to the usual statement of receipts and payments, the auditors have prepared a Balance Sheet showing the liabilities and assets of the Society as on December 31, 1927.

With your permission I should like to take the Balance Sheet first.

Dealing first of all with the assets side of the Balance Sheet, Furniture stands at Rs. 2,500, a conservative figure when one takes into account that this figure includes the show cases containing the reference collection and the book cases containing the library.

Game Books Account.—The Game Books have been separated from the ordinary publications of the Society, because the Society in this case is an equal partner with the author with regard to any profit which may be made on the sale of the Game Books.

During the year under review Rs. 2,000 worth of Game Books have been sold and this year we hope to do better. We have, as you will observe, created a reserve equal to the balance of the total stock. There is however still a sum of Rs. 5,310 due on account of Game Books. Notwithstanding this if the sales continue at their present rate it is to be hoped that a large portion of this reserve will ultimately be unnecessary.

Other publications.—The figure of Rs. 400 represents only those publications which have been in stock for less than two years. The remaining publications have all been written off although small sums of money continue to come in from these sources.

Expenses on preparation of Bird Charts.—As you are aware, the Society proposes during the current year to publish a series of Bird Charts and Books and the figure of Rs. 697-13-0 represents preliminary expenses in connection with the preparation of these publications.

Advances to staff and on account of Members.—Rs. 78-7-3. A nominal amount.

Investments.—Stand at the very satisfactory figure of Rs. 78,362-8-0 and this figure is considerably below today's market value.

Cash Balances.—A satisfactory figure of Rs. 19,156-12-8.

This concludes the asset side of our Balance Sheet making our total assets Rs. 1,01,195-8-11.

You will notice that we have not taken into account our very complete Research collection, or our stock of old Journals, or our very valuable library.

Liabilities.—Consist of Printing charges. Rs 6,000 is due on account of the current year's Journal and will be paid early in 1928. At the beginning of 1927 we paid Rs. 2907/11 on account of Journals publisned in 1926. The remaining liabilities are all on account of publications.

Donations for Specific Objects Unexpended.—This is a sum which the Society is holding as a trustee.

Life Membership Fees.—Rs. 42,600 which we have not spent and which represents the whole of the capital sum paid by life members who are still alive, and also the . . . . . of institutions, clubs, etc., compounded subscriptions.

We are left with surplus assets of Rs. 38,116-14-4.

I think you will agree that the Balance Sheet shows that the Society is in a very sound position.

Dealing now with the receipts and expenditure account. This year we have split this up under separate headings.

General Account.—In this has been included all the main activities of the Society in connection with the Journal, etc. As you will notice we have finished up the year with a satisfactory surplus on this head of Rs. 1,663-7-3.

Publication Account.—Here we have a small deficit of Rs. 111-8-10.

Special Expenditure in connection with Prince of Wales Museum and Nature Study.—The whole of the expenditure under this head has been met by special donations including during the year, very handsome donations of Rs. 5,000 each from H. H. The Maharaja of Jodhpur and Sir David Ezra, Kt., towards show cases, models, etc., and we finish up the year with a satisfactory surplus of Rs. 7,968-10-7, the sum shown in the balance sheet as being held in trust by the Society.

Cash Account.—This account is merely a summary of the other account with the addition of Entrance fees and Life Membership Fees received during the year with approximately the same amount invested on the other side, and of course the summary of our cash position.

In conclusion I would mention that the Society now consists of 188 Life Members, 1,123 Ordinary Members who have paid their subscriptions and 62 Ordinary Members who have not paid their subscriptions, making a total of 1,373 members in all. During the year we enrolled 12 Life Members, 1 old member rejoined, and 146 new Ordinary Members were elected. There was a net increase in membership of 35 during the year as I regret to state we lost 76 members through resignation.'

It was proposed by Chairman and seconded by Honorary Secretary that the audited accounts of the Society for the past year be approved—*Carried unanimously.*

On the motion of Mr. H. A. W. Brent a hearty vote of thanks for his services was passed to Mr. J. B. Greaves.

BOMBAY NATURAL HISTORY SOCIETY.

BALANCE SHEET AS AT DECEMBER 31, 1927.

LIABILITIES.	RS A P	A P	ASSETS	RS A P	RS A P
Sundry Creditors—			*Furniture*—Estimated cost	7,500 0 0	
Printers of 'Game Books'	5,310 0 0		*Less* Depreciation to date	5,000 0 0	2,500 0 0
,, ,, Identification of Indian Butterflies say	1,200 0 0		*Game Books Account—*		
,, ,, Journal	6,000 0 0		Cost of publications	65,520 10 8	
		12,510 0 0	*Less* Realized to date	50,748 0 0	
Donations for specific objects unexpended ...		7,968 10 7		14,772 10 8	
Life membership Fees		42,600 0 0	*Less* Reserve for unsaleable stock, etc.	14,772 10 8	
Surplus Assets		38,116 14 4	*Note.*—50% of any profits to be paid to Authors		
			Publications. Excluding Journal, at cost ...		400 0 0
			Note.—Any publications which have been on hand over two years have been written off.		
			Eepenses on Preparation of Bird Charts—		
			Carried forward		697 13 0
			Advances to Staff and member		78 7 3
			Investments at face value or market value whichever is Lower—		
			3½% G. P. Notes of Rs. 28,000 at 76/- ...	20,280 0 0	
			4% Govt. Conversion Loan Rs. 10,000 at 94/6	9,437 8 0	
			5% Govt. Loan (1945-55) Rs. 15,000 ...	15,000 0 0	
			6½% Bombay Development Loan 1935, Rs. 8,000	8,000 0 0	
			4% B. P. T. Ungt. Bonds Rs. 14,000 at 85/8	11,970 0 0	
			4% City of Bombay I. T. Bonds Rs. 15,000 at 84/8	12,675 0 0	78,362 8 0
			Cash Balances—		
			On Fixed Deposit with Bankers ...	15,000 0 0	
			On Current Account with National Bank of India, Ltd., Bombay	1,876 0 3	
			,, ,, ,, London ... ... £159-16-2 at 1/6	2,130 12 5	
			Cash on hand	150 0 0	19,156 12 8
			Note.—A stock of 17,000 old journals and the valuable research collection and library of 2,300 volumes have not been taken into account on the Asset side of the Balance Sheet.		
Total ...		1,01,195 8 11	Total ...		1,01,195 8 11

We have prepared the above Balance Sheet from the cash book and from information given to us, and have verified the Investments and Deposits.

In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of the information and the explanations given to us.

BOMBAY, *February 16, 1928.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) J. B. GREAVES,
Honorary Treasurer.

GENERAL ACCOUNT

RECEIPTS	RS	A	P	RS	A	P	PAYMENTS	RS	A	P	RS	A	P
To Subscriptions	28,711	8	10				By Journal Account	7,632	8	7			
,, Postal Registration	378	0	0				,, Salaries	19,946	9	0			
,, Sales of Journals	1,733	1	11				,, General Charges, Petty Cash, etc. ...	1,257	3	9			
,, Receipts from advertisement	370	0	0				,, Rent	2,436	0	0			
,, Payment by Members for mounting, etc.	925	3	4				,, Printing and Stationery	923	2	10			
,, Sundries	203	3	9				,, Postage	1,363	5	6			
,, Interest on Investments, etc.	4,203	1	4				,, Library	829	14	3			
				36,524	3	2	,, Furniture	125	0	0			
							,, Audit Fee	250	0	0			
							,, Fire Insurance	100	0	0			
											34,863	11	11
							Balance ...				1,660	7	3
Total ...	...			36,524	3	2	Total ...	...			36,524	3	2

PUBLICATIONS ACCOUNT

RECEIPTS	RS	A	P	RS	A	P	EXPENDITURE	RS	A	P	RS	A	P
To Sales of Game Books	1,985	0	0				By Messrs. Bale Sons and Danielsson, Ltd.	2,966	6	8			
,, ,, ,, Snake Charts	317	4	0				,, ,, Witherby & Co., Ltd. ...	198	6	10			
,, ,, ,, Iraq Fauna	5	14	3				,, Preparation of Bird Charts	697	13	0			
,, ,, ,, Game Bird Plates	143	7	0								3,862	10	6
,, ,, ,, Identification of Indian Butterfly	850	2	3										
,, ,, ,, Snake Books	2	12	0										
,, Other printed matters	446	10	2										
				3,751	1	8							
Balance ...				111	8	10							
Total ...	...			3,862	10	6	Total ...	...			3,862	10	6

SPECIAL EXPENDITURE IN CONNECTION WITH PRINCE OF WALES MUSEUM AND NATURE STUDY

RECEIPTS	RS A P	RS A P	PAYMENTS	RS A P	RS A P
To Balance Unexpended as on 1st January 1927 ...	6,432 0 6		By Nature Study	4,575 13 0	
,, Donations	10,000 0 0		,, Expenses on Show Cases	3,887 8 11	
		16,432 0 6			8,463 5 11
			Balance to be expended		7,968 10 7
Total ...		16,432 0 6	Total ...	...	16,432 0 6

SUMMARISED CASH ACCOUNT

RECEIPTS	RS A P	RS A P	PAYMENTS	RS A P	RS A P
To Entrance Fee received in 1927 ... —	2,980 0 0		By Investments—3½% Government Pro-Notes of Rs. 6,700	5,033 6 0	
,, Life Membership Fees received in 1927 ...	4,200 0 0		,, Excess Payments over receipts on Publications	111 8 10	
,, Opening Balances	13,608 1 5		,, Advance to Staff and Member	78 7 3	
,, Surplus on General Account	1,660 7 3		,, Amount expended from Donations for Special Purposes	8,463 5 11	
,, Donations for special purposes	10,000 0 0		,, Closing Balance	19,156 12 8	
,, Other Donations	395 0 0				32,843 8 8
		32,843 8 8	,, On fixed Deposit with :		
			The Hongkong and Shanghai Banking Corp. Bombay, 5,000 0 0		
			National City Bank of N. York Bombay 5,000 0 0		
			Bank of BarodaLtd., Bombay ... 5,000 0 0	RS A P	
				15,000 0 0	
			Balance on current account with National Bank of India, Limited, Bombay	1,876 0 3	
			Cash on hand	150 0 0	
			Balance on current account with National Bank of India, Limited, London £159-16-2 at 1/6 ...	2,130 12 5	
			Total ...	19,156 12 8	
Total ..	...	32,843 8 8	Total ..	...	32,843 8 8

BOMBAY, *February 16, 1928.*
Examined and found correct.
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) J. B. GREAVES,
Honorary Treasurer.

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